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VOLUME 121

NUMBER 3149

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# Radiocarbon Dates of Pre-Mankato Events in Eastern and Central North America

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THE discovery of natural radiocarbon by W. F. Libby and its application for age determinations has led, during the past few years, to a unique method for stratigraphic correlation and for dating many events that followed the Mankato glacial maximum (see, for example, articles by Flint and Deevy, 1 and Flint, 2). The progress of the carbon-14 dating technique, particularly the substitution of gas counting for solid-carbon counting developed by Suess (3), has extended the possible range of dates from about three half lives to more than six and has thereby opened the way for fixing in time the events of the last major glaciation preceding the Mankato in North America and its European equivalent, the Fennoscandian. A group of samples related to the earlier phases of the Wisconsin glaciation was therefore assembled by Flint with the cooperation of numerous collectors and was measured by Suess at the U.S. Geological Survey radiocarbon laboratory (4). Since the consistency of the results became apparent, additional related samples have been collected and measured (5).

This article (6) attempts a brief critical assessment of the stratigraphic meaning of these pre-Mankato samples. It does not pretend to be a compendium or detailed description, for it is expected that the collectors will publish full evaluations pertaining to their respective field areas.

## Primary Considerations

Most of the samples discussed consisted of wood, a substance believed to be best suited for radiocarbon dating. Each date derived from a  $C^{14}$  determination is subject to two types of error, the laboratory error and the field error. The latter embraces three possibilities: (i) erroneous stratigraphic correlation of the sample; (ii) admixture of foreign materials such as modern roots; and (iii) the results of natural isotope fractionation during growth, burial, and partial decomposition (7). The errors listed by experimental investigators include laboratory error only. Usually expressed as standard errors (8), they include statistical counting error, uncertainties in background and calibration, isotope fractionation during preparation of the sample, uncertainty in the accepted  $C^{14}$  half life of 5568 yr, and other factors.

Radiocarbon dates are derived on the probable assumption that secular production rate and diluting

carbon reservoir are constant. Any actual deviation from this assumption will change the absolute time scale but not relative age. For this reason we use the term *radiocarbon years* in this paper, even though such deviation is probably insignificant.

Although the laboratory errors listed with the date of each sample can readily be considered in evaluating and correlating the dates, unrecognized field errors may occasionally lead to wrong conclusions. Therefore an adequate statistical population of dates is necessary before obviously erroneous results can be excluded. However, the consistency of the group of dates under consideration is such as to justify the assumption that all are accurate. Our discussion is based on that assumption.

## General Results

From the dates of samples measured before 1 Dec. 1954, these general inferences are drawn:

1) Although some of the dates fall into a somewhat different order from that of the stratigraphic units to which they had been assigned, their order is reasonable and implies no physical improbabilities. The discrepancies are believed to result from errors in stratigraphic correlation that are inherent in any field study of successive sheets of till and loess in which no fossils are present to aid correlation.

2) A major glaciation began 25,000 or more yr ago, reached a maximum about 20,000 to 18,000 yr ago, and was in oscillating retreat between 13,000 and 12,000 yr ago. The Mankato advance, a later fluctuation, is not under discussion in this article.

3) If the  $C^{14}$  dates are accepted as a more reliable basis of correlation than that afforded by field methods in the absence of fossils, existing correlations and nomenclature will need some revision.

The samples discussed fall into three age groups, designated temporarily as *young*, *middle*, and *old*. We begin with the young group, in which the samples are correlated with the Cary substage of the Wisconsin stage of glaciation, either with assurance or with probability, and then turn to samples less firmly correlated.

## Young Group of Samples

*Lake Arkona, Cleveland, Ohio* (W-33) (9). An event securely fixed in the late-Wisconsin stratigraphic sequence is the rise of the glacier-dammed lake in the Erie basin from the low-water Arkona phase to the

Whittlesey phase (10). That event resulted from a re-advance of the ice-sheet margin to the Port Huron moraine, and occurred late in Cary time (11). It entailed a rise of the water surface of about 45 ft.

A sample of broken twigs, roots, and leaves was collected by G. W. White and J. D. Winslow from a horizon representing a Lake Arkona lagoon, exposed in the southern part of the city of Cleveland. Lying at an elevation of 690 ft, the Arkona horizon is overlain by 10 to 12 ft of sand and silt deposited in the lake as it deepened during the rise to the Whittlesey beach, well developed in the vicinity. The wood, identified as cedar, is interpreted by the collectors as having grown around the shore of the lagoon. Its date,  $13,600 \pm 500$  yr (12), is reasonable in that it antedates the peat layer at Two Creeks by about 2000 yr, an interval during which the glacier margin advanced to the Port Huron moraine and then retreated to or north of the Strait of Mackinac. The implied minimum rate of displacement of the glacier margin is no greater than rates observed on existing glaciers.

*Dyer spit, Ind.* (W-140; W-161). During retreat of the ice-sheet margin from the Port Huron moraine, and therefore after the Lake Arkona lagoon was covered by Lake Whittlesey sediments, the additional discharge from lakes in the Huron-Erie basin deepened the Chicago outlet, lowering Lake Chicago from its Glenwood position to its first-attained Calumet level (11, p. 425; 13, p. 32). Prior to that lowering, and during Glenwood time, an eastward-growing spit near Dyer formed a bay in which driftwood and peat accumulated. Shortly thereafter a second spit grew westward over this material. Samples of wood were collected by J. H. Bretz, L. Horberg, and M. Rubin from the peat horizon and from within the overlying second spit itself. The wood at the peat horizon (W-140) gave a date of  $12,650 \pm 350$  yr, and the wood from the younger spit (W-171) gave a date of  $12,200 \pm 350$  yr—an internally consistent sequence in general agreement with the afore-mentioned Lake Arkona date.

*Durham Meadows, Conn.* (W-46). An accumulation of peat and gyttja forming Durham Meadows overlies clay, sand, and gravel tentatively correlated, before dating, with late Tazewell or Cary drift by Flint (2). A complete section of the deposit was obtained and pollen analyzed by Estella Leopold. A sample of gyttja from 2.5 ft above the top of a gravel outwash, recording a point on a line of transition from a spruce maximum to a pine maximum, implying a change toward a warmer climate, gave a date of  $12,700 \pm 250$  yr. When compared with the Lake Arkona (W-33) and Dyer (W-140, W-161) dates, this appears to be a reasonable late Cary date and implies that the underlying drift is probably Cary rather than Tazewell.

*Poggewisch, Holstein, Germany* (W-93). A sample of gyttja was collected by Alfred Rust from a bog occupying a kettlelike basin at Poggewisch, near Hamburg. The basin occurs in drift sheets laid down during oscillating retreat of the ice-sheet margin from the Pomeranian position. The sample, taken from a sequence firmly tied to the pollen stratigraphy by R.

Schuttrumpf, belongs to pollen zone I of the German sequence—tundra phase of the older Dryas zone underlying the Alleröd zone. Because the latter is the radiocarbon-dated equivalent of the forest-bed horizon at Two Creeks, which directly overlies Cary drift, the Pomeranian drift had been expected to be at least in part equivalent to the Cary. The date of the sample,  $15,150 \pm 350$  yr, is consistent with the expectation in that, when compared with the Lake Arkona and Dyer dates, it is a reasonable Cary date. Hence it strengthens the belief that the Pomeranian glacial substage is correlative with a considerable part, if not all, of the Cary glacial substage, and that late Wisconsin climatic fluctuations in western Europe were at least broadly synchronous with those in eastern North America.

*Avilla, Noble County, Ind.* (W-58). A series of samples were collected in northeast Indiana by W. J. Wayne from organic deposits in or associated with glacial deposits believed to be of Cary age. Sample W-58 is wood taken from the base of a black, fossiliferous peaty clay overlying gravel outwash. Spruce cones and needles were found in abundance with the wood. The clay is overlain by 3 ft of calcareous gravel and sand topped by 3 ft of alluvial sand and silt. The organic zone is believed by Wayne to represent deposits in a lake dammed either by ice to the east, possibly at the Wabash moraine position, or by a valley train along Eel River. Wayne (14) considers the overlying gravel to be nonglacial alluvium rather than glacial outwash. The date of the wood is  $12,380 \pm 300$  yr.

*Laketon, Wabash County, Ind.* (W-64). Another sample of gyttja from under 12 ft of marl, collected by Wayne, was determined to be  $13,140 \pm 400$  yr old. The gyttja is the bottom deposit in a kettle lake situated in a broad outwash area along the distal edge of the Packerton moraine (15) in the Saginaw lobe. Wayne (14) considers it more likely that the large ice block responsible for the kettle constituted part of the glacier at the Packerton moraine rather than that it was floated by meltwater from the nearest moraine of the Erie lobe. A hasty pollen study of the sample layer showed that, of 56 pollen grains counted, 89 percent were spruce and fir.

*Fremont, Steuben County, Ind.* (W-65). A third Indiana sample comes from an outwash plain extending west and north from the Wabash moraine, in a section exposed in a drainage ditch 3 mi southeast of Fremont. Tough lacustrine clay overlies a few feet of gravel and sand in an exposure about 1000 ft northwest of the road. Beneath these deposits, nearer the road, a thin unit of marl and peat overlies unweathered till. The peaty layer seems fairly continuous. Wood fragments from the peat were dated at  $13,020 \pm 400$  yr. The origin of the gravel above the organic material is not certain. Inasmuch as no stream existed in this broad flat area until a ditch was dug a few years ago, Wayne concluded (14) that the gravel was either outwash deposited at the time the ice constructed the Wabash moraine, less than 1 mi to the east, or a deposit from melting residual, stagnant ice.

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masses. Of 200 pollen grains counted from the sample, 79 percent were spruce and fir.

*Edon, Ohio (W-198).* A date of  $14,300 \pm 450$  yr was determined for a sample from the Wabash moraine near Edon. Sample W-198 was collected from a thin zone of organic litter 3 ft above the base of a 10-ft silt section along the crest of the Wabash moraine. The topography is such that the silt must have been deposited in a pond or lake dammed either by a large mass of stagnant ice or by the glacier itself. The section was exposed during excavation for the Ohio Turnpike a few miles east of the Indiana border; the sample was collected by W. J. Wayne, R. P. Goldthwait, J. Zumberge, D. Eschman, and M. Rubin.

The dates of the Wabash moraine ( $14,300 \pm 450$  yr) and Lake Arkona ( $13,600 \pm 500$  yr) samples are in correct relationship to each other even though many lake stages and minor glacial advances are crowded between them. However, the younger dates of  $12,380 \pm 360$  and  $13,020 \pm 400$  yr obtained from samples W-58 and W-65 (Avilla and Fremont), respectively, suggest that these Indiana samples do not record a time when the ice front stood at the Wabash moraine position, but represent the first deposits laid down shortly after the main body of ice left the immediate area. As such, the Indiana sample dates are in good agreement with the Ohio pair.

#### Middle Group of Samples from Ohio, Ontario, and Pennsylvania

*Ohio samples.* Seven samples from Ohio, furnished by R. P. Goldthwait, are alike in that they consist of spruce wood from logs and branches imbedded in till or, in one instance, lacustrine silt. Evidently they record forest trees destroyed and dispersed by advancing glacier ice. Their numbers, locations, and dates are assembled in Table 1. The map, Fig. 1, shows the positions of these samples in relation to the boundaries

of the Cary and Tazewell drift sheets as they were tentatively drawn before the samples were dated. It is probably significant that the oldest sample, W-71 (Cleveland), lies farthest upstream measured in terms of the direction of flow of the ice sheet, whereas the next oldest, W-188 (Sidney), lies in an intermediate position, and the remaining five samples lie near the outer limits of the related drift sheets. It must be assumed that each piece of wood was carried only a short distance by the ice, for if this had not been true, the dates would not agree with the geographic occurrences of the samples. From the positions of these samples and from their dates it can be reasonably inferred that in an advance of major proportions the ice sheet invaded Ohio beginning about 25,000 yr ago, overwhelming spruce forests successively during its southward advance, which culminated about 18,000 yr ago. During the advance, apparently 7000 yr in duration, and during the subsequent deglaciation, the ice margin oscillated, as can be inferred from the several end moraines it built.

Special interest attaches to sample W-188 ( $23,000 \pm 800$  yr), the only sample from a locality in which the till with fossil logs directly overlies a soil developed in an older till. The soil does not resemble a gumbotil; hence the older till is probably not Illinoian. This relationship establishes the inference that the glacial advance that overwhelmed the forests was not the earliest post-Illinoian glacial invasion of Ohio, but was separated from an earlier post-Illinoian glaciation by an interval of soil development. This earlier glaciation probably postdates the Sangamon interglacial stage and is older than what has been recognized as Wisconsin. We believe that the Wisconsin stage might have to be adapted to include it.

The exposure from which sample W-188 was taken is a railroad cut a few miles south of Sidney, Shelby County. The exposure was examined and sampled by

Table 1. List, brief description, and  $C^{14}$  dates of the middle group of samples from Ohio. All samples consisted of spruce wood. For description and discussion of Chicago samples see Libby (8, 25, 26) and Flint and Deevey (1).

Sample No.	Locality and collector	Stratigraphy	$C^{14}$ age (yr)
W-37	Dayton (R. P. Goldthwait)	Imbedded in till believed, before dating, to be of Cary age. Identical with C-508, which dated $> 17,000$ yr.	$20,700 \pm 600$
W-71	Cleveland (R. P. Goldthwait)	Imbedded in lake silt overlain by till believed, before dating, to be late Cary in age, and underlain by loess (44, p. 366, unit 6).	$24,600 \pm 800$
W-88	Newark (R. M. Mahard)	Imbedded in till believed, before dating, to be of Tazewell age. Overlain by outwash believed to be Cary in age. Similar to sample C-893, which dated 16,100 yr.	$21,400 \pm 600$
W-91	Chillicothe (R. P. Goldthwait)	Imbedded in till believed to be of Tazewell age.	$18,050 \pm 400$
W-92	Oxford (R. P. Goldthwait)	Imbedded in till believed, before dating, to be Cary in age. Underlain by lake sediments. Identical with sample C-465, which dated $> 15,000$ yr.	$19,980 \pm 500$
W-127	Harrisburg (P. F. Mooney)	Imbedded in sand lens in till believed, before dating, to be Cary in age.	$21,600 \pm 1000$
W-188	Sidney (J. Forsyth)	Imbedded in till believed, before dating, to be of Cary age. Underlain by an older till in the surface of which a well-zoned soil of the Fox series is developed.	$23,000 \pm 800$



Fig. 1. Sketch map showing localities, accession numbers, and dates of significant samples. Drift borders, diagrammatic only, are compiled from the Glacial Map of North America and other sources.

Jane Forsyth. The logs are overlain by more than 20 ft of till and mark the upper contact of a well-zoned soil developed in an older till at least 30 ft thick. The soil is completely leached to a depth of at least 48 in. and is partly leached to a depth of 6 ft. The tills above and below the soil are calcareous.

This soil is believed by R. P. Goldthwait (16) to be similar to a soil of the Fox series developed extensively throughout south-central Ohio on gravel bodies sandwiched between two tills. Within a few miles in many directions from the Sidney locality, the buried soil occurs on the gravel body that separates the two tills at Sidney. This fact lends weight to the supposition that the soil on the till is of the same age as that on the gravel. If the supposition is correct, the glaciation recorded by the lower till and the gravel was extensive.

The soil, as well as the till and gravel in which it is developed, is believed to be post-Sangamon and pre-Wisconsin of existing terminology. The alternative possibility, that the soil is Sangamon and the drift beneath it Illinoian, is unlikely because weathering of the till is not comparable to that developed on drift of known Illinoian age. Using Kay's familiar depth-of-leaching value of 2.5 ft on Mankato drift, and modifying the related time to 10,000  $C^{14}$  yr, we have a buried soil at Sidney whose 48-in. leached zone represents roughly 16,000 yr. The predominant surface till in the area, presumably deposited a short time

prior to the formation of the Wabash moraine, developed a soil with a depth of leaching of about 43 in. (17); this implies a weathering interval of a little more than 14,000 yr. Because this figure should represent the length of time the area has been free of ice, the date of 14,300 yr for the Wabash moraine, the southern arc of which swings just north of this area, is in fair agreement.

Samples from Ohio that record the time between the maximum of the inferred glacial advance (18,000 yr) and the time of Lake Arkona (W-33, 13,600 yr) are scarce. This could result from the likelihood that trees would not occupy the periglacial zone soon enough to be destroyed by minor readvances, or it may be purely artificial. At any rate, on the basis of the Ohio evidence alone, there is no reason to doubt that the elapsed time, about 4500 yr, represents the irregular waxing of the glaciation recorded by the fossil logs. In that case the middle group of samples is related to the expanding phase, and the young group is related to the later phases of shrinkage of the ice sheet during a major glacial event. The whole event, then, as measured in Ohio, embraced at least 7000 yr plus 4500 yr, or 11,500 yr. It will be shown that evidence from other states is consistent with this interpretation.

At five of the seven sample localities in Ohio the enclosing sediment had been assigned with varying certainty to the Cary substage; at the remaining two

it had been assigned to the Tazewell (18). The possibility exists that the logs from Cleveland (W-71) found at the base of pro-Tazewell (?) lake silts are derived from an underlying loess that has been correlated with Farmdale loess (19) by A. B. Leonard (20) on faunal evidence.

In Illinois, the material deposited contemporaneously with this advance, as will be shown by dates from additional samples, has been named Farmdale, Iowan, and Tazewell, whereas the till deposited around the lake border during the pre-Mankato retreat phase has been termed Cary.

*Plum Point, Ontario* (W-177). From the north shore of Lake Erie comes a sample that fits reasonably into the reconstruction of events in Ohio. At Plum Point, 2 mi southwest of Port Talbot the modern Lake Erie cliff exposes two different till sheets separated by a few feet of lacustrine clay. Within the lower till, 12 ft below its top, are fragments of larch wood. Because the locality lies outside the supposed Mankato drift border and because the upper till antedates a strandline believed to be that of glacial Lake Maumee, a Cary lake, the upper till is considered to be pre-Mankato. Wood from the lower till, collected by Aleksis Dreimanis, yielded a date of  $27,500 \pm 1200$  yr. The date, of course, is consistent with the pre-Maumee correlation of the overlying till, for Lake Maumee should have existed more than 13,600 yr ago (W-33, Lake Arkona) and considerably less than 18,000 yr ago (W-91, Chillicothe). But it is consistent also with the Ohio reconstruction, for the glacial advance that overwhelmed a forest near Cleveland about 24,600 yr ago (W-71, Cleveland) and reached southern Ohio 7000 yr later can reasonably be expected to have been responsible for the lower till at Plum Point, 60 mi north of Cleveland, some 3000 years earlier. The upper till and underlying clay at Plum Point may well date from a much later time, shortly before the creation of Lake Maumee or even during the existence of that lake.

*Bridgeville, Pa.* (W-66). Also consistent with the group of dated samples from Ohio is a peat sample furnished by E. R. Eller from a section near Bridgeville, well described by Schopf and Cross (21). The peat lies conformably between two lake deposits 8 mi south of the Ohio River in the valley of one of its tributaries, Chartiers Creek, and 25 to 30 mi south of the border of the Wisconsin drift. The altitude and areal position of the peat in relation to abundant remnants of outwash fill in the Ohio River valley and of backwater fill in the tributary invite the explanation that ponding was caused by two episodes of rapid outwash aggradation along the Ohio, both of Wisconsin age. The earlier episode created a pond that filled with sediment and continued as a bog; the later flood of outwash reached a higher altitude, recreated the backwater pond, drowned the bog, and covered it with lacustrine clay. Later dissection led to present conditions. The time interval between the pondings is unknown; Schopf and Cross tentatively referred the peat to the Tazewell-Cary interval. However, the conformability of the peat with the overlying lake clay

and its particular boreal ecology (spruce, tamarack, hemlock, pine, and mosses) suggest glacial conditions presaging an advancing ice front rather than warm interstadial conditions.

The sample is from an unknown position in the peat which, however, is only 3.5 ft thick; its date,  $23,000 \pm 800$  yr, is nearly that of the Sidney sample (W-188), and represents a time in which it is probable that glacier ice in eastern Ohio was pouring outwash down the Beaver River into the Ohio River valley. If viewed as an indirect product of the important glacial advance in Ohio, the date is compatible with the Ohio dates cited. Drowning of the bog must then be attributed to increased outwash deposition both at the time of maximum advance (about 18,000 yr ago) and during the subsequent deglaciation when the rate of melting presumably was greater than it was during the glacial advance.

*Abri Pataud, France* (W-151; W-191). From the important archeological site at Les Eyzies, in the Dordogne region of France, two samples were collected by H. L. Movius (22) from the Upper Perigordian IV culture zone. Two independent determinations made on charcoal hearth samples, dated  $23,600 \pm 800$  and  $24,000 \pm 1000$  yr. Although these deposits have not yet been correlated with the nearest glacial drift, that in the French Massif Central, the dates suggest contemporaneity of the Upper Perigordian IV culture with a part of the Wisconsin advance into the United States.

#### Samples from Iowa

*Hancock* (W-141). A complete sequence of dates from Iowa affords an interpretation somewhat similar to that made for Ohio. One date,  $24,500 \pm 800$  yr, obtained from wood in a railroad cut near Hancock, is representative of the middle group from Ohio; a series of five dates from two localities, obtained at the Chicago laboratory, represents the young group; two of the dates are from intermediate horizons.

W-141 consisted of wood fragments from the top of a loess sheet 3 to 4 ft thick overlying Loveland loess. Above the sample horizon is a third loess sheet 28 ft thick. According to the collector, R. V. Ruhe (23), the third loess contains two gastropod zones, the upper indicative of the Tazewell substage, the lower of the Iowan substage. On the basis of its stratigraphic position, Ruhe (24) correlated the sample horizon with the Farmdale loess (19) of Illinois; the radiocarbon dates support the correlation.

By the use of radiocarbon dates, the advance of the glacier from which the dated Farmdale loess at Hancock was derived can be correlated with the major advance in Ohio. The logs from Cleveland (W-71,  $24,600 \pm 800$  yr) overlie a similar loess, that is also correlated with the Farmdale loess. However, although the Cleveland area was overridden, the ice of this advance did not reach the Hancock locality. Although a weak incipient soil is developed on the Farmdale loess at Hancock, such a soil does not necessarily imply complete deglaciation. Therefore the section above the Loveland loess can be interpreted as belonging to a

single major fluctuating glacial advance followed by retreat.

*Cook Quarry, Story County* (C-596, C-653, C-664) and *Lizard Creek, Webster County* (C-912, C-913). Five dates from Iowa reported by Libby (25, 26) range from approximately 12,000 to 14,000 yr, placing them in the young group of samples. The occurrences are fully described in a paper by R. V. Ruhe and W. H. Scholtes (27). In brief, the Cook Quarry section consists of two tills, the lower one oxidized, separated by a sand-and-gravel layer, also oxidized. C-596 averaged  $11,952 \pm 500$  yr and C-653 averaged  $12,200 \pm 500$  yr. Both samples consisted of wood from the upper till. C-664, a sample taken from the intervening sand-and-gravel layer, was dated at  $14,042 \pm 1000$  yr. The upper till was classified by Ruhe as Cary in age (28). Contemporaneous events, correlated by radiocarbon dates from Ohio and Indiana, indicate a somewhat similar glacial fluctuation.

The Lizard Creek dates,  $12,120 \pm 530$  yr (C-912) and  $13,300 \pm 900$  yr (C-913), are from samples of hemlock that occur in horizontally bedded silts and sand-and-gravel bodies underlying Mankato till. A late Cary outwash genesis for the sample horizon is logical in view of the agreement between these and previously cited young samples.

*Mitchellville, Polk County* (W-126) and *Clear Creek, Story County* (W-153). The Iowa series of dates does not show the gap between the middle and young groups that was observed in Ohio; instead the series bridges the gap with samples coming from a generally constant glacial loess accumulation. Samples W-126 and W-153 lie between the middle and young groups of dates in both stratigraphy and radiocarbon age. The Mitchellville sample is from within a 29-ft loess section underlying 5 ft of till; the date obtained at the Washington laboratory was  $16,720 \pm 600$  yr. The overlying till is part of the marginal minor-morainal belt of the Des Moines lobe reclassified by Ruhe in 1952 as of Cary age (28). Probably the loess at Mitchellville is correlative with the 28 ft of loess above the Farmdale loess at Hancock, if the faunal descriptions by C. Cameron (discussion of Mitchellville section by Ruhe and Scholtes, 27, p. 84) are considered. If this correlation is valid, wood giving any date between the 24,500-yr date from Hancock and the young group (12,000 to 14,000 yr) might be obtained from various horizons of this loess.

For example, at the Clear Creek section various layers of silt and loess are sandwiched between two till sheets. The surface till, here 10 ft thick, belongs to the drift reclassified by Ruhe as Cary (28). The basal till may be either Iowan or pre-Wisconsin. A sample of hemlock (W-153) obtained from a zone of concentration of wood fragments about midway in the 30 ft of loess and silt in the section gave an age of  $14,700 \pm 400$  yr.

The presence of yew, spruce, and hemlock in the flora of the 58-ft thick loess deposit at Mitchellville (29, pp. 169-171) and the presence of hemlock at Clear Creek point to an environment significantly colder and moister than that of present-day Iowa with its prairie grasses and deciduous trees. The bur-

ial of wood in accumulating loess is consistent with a glacial rather than an interglacial time of origin, possibly reflecting a fluctuating ice front disturbing the customary equilibrium of loess deposition and vegetal decomposition. The evidence from Iowa is not prejudicial to the interpretation of a single major glaciation made from the Ohio data. The record shows that between 25,000 and 12,000 to 13,000 yr ago, several glacial fluctuations occurred in Iowa. It is not our intention to deny the reality of their existence. We wish to show only that they belong logically within a single major glacial advance and retreat.

#### Middle Group Samples from Illinois and Indiana

From classic sections of the Wisconsin glacial stage in Illinois come four samples representing the middle group of dates. The large body of information amassed through the years by workers in that state affords a formidable test of the validity of radiocarbon dating.

*Farm Creek, Ill.* (W-68, W-69). Two samples of wood from the famous exposures along Farm Creek near Peoria described by Leighton (30) were previously determined by Libby (C-509 and C-510) to be greater than 19,000 and 20,000 yr old, respectively. The samples were collected by G. D. Smith and C. S. Denny from 0 to 1 ft and 3 to 4 ft below the surface of the Farmdale loess. The stratigraphy of the Farm Creek exposure from surface to base consists of: (i) Shelbyville (Tazewell) till; (ii) Iowan loess; (iii) Farmdale silt and loess of Leighton and Willman (19); and (iv) Illinoian till capped by a Sangamon weathering profile including gumbotil. With the improved acetylene method of dating, the top sample gave an age of  $22,900 \pm 900$  yr and the lower sample  $25,100 \pm 800$  yr. These ages are in perfect agreement with the Farmdale sample of Hancock (W-141) and the possible Farmdale of Cleveland (W-71).

*Wedron, Ill.* (W-79). Another sample from the Farmdale (19) is that collected by J. H. Bretz from Lake Kiekapoo deposits at Wedron. These deposits, originally described by Willman and Payne (31, p. 307, sec. 68) as Shelbyville (Tazewell) drift, have since been considered by the Illinois Geological Survey (32, p. 38) to represent a Farmdale lake. The radiocarbon age of  $24,000 \pm 700$  yr supports this suggestion. Shelbyville (Tazewell) till overlies the same horizon.

*Farmdale Dam, Ill.* (W-187). One-eighth of a mile southeast of the point where the Farm Creek samples were taken, a sample was collected by Leland Horberg from an exposure in a railroad cut with an almost identical stratigraphy (32, pp. 18-19); Horberg described a weathering profile on the Farmdale here (33). The sample (W-187), wood fragments, came from the lowest 1 ft of the Shelbyville till and was dated at  $19,200 \pm 700$  yr. This date agrees with that of sample W-165 from below Tazewell till across the state line in Indiana.

*Greencastle, Ind.* (W-165). In a section exposed 1 mi southwest of Greencastle, a silt body 14.5 ft thick overlies Illinoian gumbotil and is overlain by 15 ft of till. A sample of wood submitted by C. L. Bieber from 1.5 ft below the top of the silt was dated at

19,500  $\pm$  800 yr. If the boundary between the Tazewell and Illinoian in Illinois is projected eastward to the collecting site, the overlying till becomes a very probable correlative of the Shelbyville (Tazewell) till in Illinois.

These dates from Illinois and Indiana fall into a reasonable relative sequence. The only objection that might be raised is the short span of time allotted for events previously believed to have occupied a much longer interval. Approximately 3500 to 4000 radiocarbon yr are permitted for weathering of the Farmdale loess, deposition of loess of Iowan age, and the advance of Shelbyville ice to the two sample sites (W-165 and W-187). If the measured years are considered to be absolute years, the suggestion made for the samples from other states, that these deposits represent a single major fluctuating advance and retreat, becomes almost necessary. The two dates from Illinois and Indiana are in perfect accord with the dates from the outer limits of the glaciation in Ohio, and the samples mark similar outermost positions of a former ice sheet.

Acceptance of the radiocarbon dates obtained from Illinois samples requires no change in the existing stratigraphic terms, although it might require the addition of a new unit to the base of the Wisconsin sequence as currently understood. A reevaluation of the significance attached to the substages mapped might also be appropriate. Leighton wrote (32, p. 9):

The longest intraglacial interval, according to the record in Illinois, appears to have been that between the deposition of the Farmdale loess and that of the Iowan loess.

As mentioned previously this interval, plus the time required for deposition of loess of Iowan age (and hence for the Iowan glaciation), and plus the time represented by the advance of the Tazewell glacier, can hardly exceed 4000 C<sup>14</sup> yr.

The brief duration in C<sup>14</sup> years allotted these events forces a reconsideration of the time relationships among the substages and suggests the possibility that the Tazewell and Iowan are penecontemporaneous substages. Leighton (32, p. 8) recognized this possibility and asked,

Are the Iowan and Tazewell separate substages, or did the Iowan ice, because of shorter distance from its radiation center, reach eastern Iowa before the Tazewell ice reached northeastern Illinois?

Evidence of their near synchronous nature was observed by Ruhe in northwestern Iowa (28). He reported no difference in degree of integration of drainage between the Iowan and Tazewell drift surfaces there. The apparent contraction of time proposed here becomes still more plausible if the shortness of the Tazewell-Cary interval in Illinois is considered. Leighton (32, p. 9) stated, "The difference in leaching of youngest Tazewell drift and the oldest Cary drift is scarcely significant."

The evidence from Illinois is not adverse to the concept of a major glaciation beginning with deposition of the Farmdale loess at some time prior to 25,000 yr ago, advancing with fluctuations to its outermost

Shelbyville (Tazewell) position at 19,000 yr, and retreating with fluctuations (Shelbyville moraine to Marseilles moraine) into the Lake Michigan basin before an oscillating (Cary) advance at 12,000 to 14,000 yr ago. (Minooka, Valparaiso, and Lake Border moraines.)

#### Old Group of Samples

A group of 15 samples from 13 localities in eastern North America is distinct from the middle group previously described in that they belong in a separate category consisting of much older materials. Each of the dates for samples in this old group is a *minimum date only*; it is not known in the case of any sample how much older the sample is than the minimum date quoted. In this respect this group of samples is in the same state of uncertainty as were most of the pre-Two Creeks samples in 1950, the time when the C<sup>14</sup> date of the horizon at Two Creeks was established by Libby (see, for example, Flint and Deevey, 1).

Most of the samples within the old group were presumed to be a part of the Wisconsin stage, but in no case could the sample be conclusively shown to be Wisconsin in age. Accordingly, in each instance the possibility that the sample is pre-Wisconsin must be admitted.

We begin the descriptive comments with the samples from Ohio, for the substantial time interval between the middle group and the old group is most clearly evident in the samples from that state.

*Germantown, Ohio* (W-96). A portion of a log collected between 1870 and 1890 from the section at Twin Creek near Germantown by either G. F. Wright or Edward Orton was submitted by R. P. Goldthwait and was dated as older than 34,000 yr. The complete section as described by Leverett (34) is no longer exposed, but Goldthwait described the section on the basis of borings from wells drilled more recently on farms nearby (16). The well logs indicate 60 to 90 ft of till underlain in turn by organic matter (the sample horizon) and by a thick valley fill of gravel. Goldthwait believes the till overlying the sample horizon is the till sheet from which sample W-37 (Table 1) was collected.

*North Hampton, Ohio* (W-152). This sample, a piece of a log from a stream-bank exposure 2.5 mi west of North Hampton, was dated as older than 39,000 yr. According to R. P. Goldthwait, who submitted the sample, the position of the forest bed, from which it was taken in the Ohio stratigraphic section is not certain. However, the section was believed originally to represent deposits of Wisconsin age.

*Otto, N. Y.* (W-87). At Otto, near Cattaraugus, in western New York, a layer of peat overlies leached Illinoian(?) till and is overlain by gravel interpreted as outwash of MacClinton and Apfel's Olean drift of early Wisconsin(?) age. Pollen analysis of the peat indicated dominant fir, spruce, and pine, implying a cooler climate than that now existing at the locality. MacClinton and Apfel (35, p. 1152) tentatively assigned the peat to a late part of the Sangamon interglacial stage. A sample of the peat, collected by C. S. Denny, was dated as older than 35,000 yr.

*Lake Bloomington Spillway, Ill.* (W-67; W-186). Two samples of wood fragments were run from a section exposed along the spillway of Lake Bloomington, McLean County, the second because of the apparently anomalous date obtained from the first run. The samples were collected by J. H. Bretz and L. Horberg from just above (W-67) and just below (W-186) a boulder pavement in gray till. Because of field relationships the exposure is considered to represent only Tazewell till. The samples come from a low position in a stratigraphic section containing tills of Shelbyville, LeRoy, Bloomington, and Normal age. The first sample (W-67) was determined to be older than 34,000 yr and the second (W-186) 31,000 yr or older.

*Independence, Iowa* (W-139). From a section originally classified as Wisconsin (?), W. H. Scholtes and R. V. Ruhe submitted a sample of wood that gave an age of greater than 38,000 yr. The wood came from a layer of peat and silt underlying a sequence of deposits, from surface downward to sample horizon, as follows: 3 ft of Iowan loess; 8-in. pebble band; 7.5 ft of Iowan till; and 2 ft of silty clay. The sample horizon was designated by the collectors "pre-Iowan Wisconsin (?)" [sic], younger than Illinoian and older than Iowan.

*Brookings, S. D.* (W-115). In 1953 a piece of wood from a well-drilling operation in sec. 26, T110N, R48W, Brookings County, was submitted for dating by G. A. Avery. The surface drift sheet at this locality is Iowan in age (36). The wood came from a depth of 140 ft, but from the information available it was not possible to form an opinion about the stratigraphic position of the wood, beyond the statement that it is either Iowan or pre-Iowan. Its  $C^{14}$  age is greater than 30,000 yr.

*Bronson, Minn.* (W-102). A sample of peat from a boring at Bronson, Kittson County, collected and studied by C. O. Rosendahl (37), was dated by the solid-carbon method (sample C-496) as older than 19,000 yr; its stratigraphic significance was discussed by Flint and Deevey (1, p. 289). Representing a spruce-tamarack forest overwhelmed *in situ* and overlain successively by stratified sediments, till, and silt deposits of glacial Lake Agassiz, the peat, dated by the acetylene method, gave a date of greater than 36,000 yr. The climate implied by the peat is much like that in the same district today. The assembled evidence clearly records a glacial advance over the locality.

*Redwood Falls, Minn.* (W-99). A piece of spruce wood found at a depth of 9 ft in till exposed in a stream bank 3.5 mi east of Redwood Falls was collected by R. Schneider and submitted by H. E. Wright, Jr. The till was presumed to be Mankato in age, and the wood, though probably transported and conceivably derived from an older till, was expected to give a Mankato or Two Creeks date. The actual date, older than 31,000 yr, suggests the presence of a much older till in the general region.

*Ironton, Minn.* (W-101). A third Minnesota sample comes from sand and silt beneath several tills in the Manuel strip mine, Cuyuna iron range, central Minnesota.

H. E. Wright, Jr., the collector, described two Mankato drifts and one or two Cary drifts in the immediate area (38). The sample, spruce wood, was taken from a depth of 180 ft, 12 ft above bedrock, and was determined to be older than 32,000 yr.

The rather young limits placed on these last two samples and on sample W-115 do not necessarily mean that they are younger than the other samples in the old group. They were run during a time of unusually high atmospheric radioactive contamination, and conservative limits were therefore set. Conceivably the three samples from Minnesota may have come from a single stratigraphic horizon.

*Port Talbot, Ontario* (W-100). Near Port Talbot, and about 1 mi northeast of the Plum Point exposure previously described (W-177) in this article, the Lake Erie cliff exposes gyttja beneath the base of the lower of the two till sheets present at Plum Point (39). Pollen examination of the gyttja yielded evidence that forests near the locality consisted mainly of jack pine and spruce (40). A sample of the gyttja yielded a  $C^{14}$  date of greater than 33,000 yr. Therefore the non-glacial time recorded by the gyttja antedates by at least 5500  $C^{14}$  yr the nonglacial time represented by the wood from Plum Point (W-177). The actual interval between the two times is unknown and may be very much greater.

*Toronto Subway, Ontario* (W-121). Excavations for the recently completed rapid transit subway beneath Toronto exposed two tills. These are separated from a third underlying till by peat and other sediments correlated by Watt (41) with the well-known Toronto formation of Coleman (42) and considered by Watt to be Sangamon in age. The peat, collected by Watt and examined for pollen by N. W. Radforth (43) proved to be rich in pine and birch with substantial quantities of spruce and fir in addition. The pollen study suggested a climate not unlike the present climate of Toronto, and slightly cooler than that implied by the flora of the Toronto interglacial beds. A  $C^{14}$  date on the peat, greater than 30,000 yr, is consistent with Watt's correlation, although it does not exclude Wisconsin correlation of the peat exposed in the subway.

*Amber, Ontario* (W-194). A peat ball, taken by A. Dreimanis from the Markham gravel pit, 1.5 mi north of Amber gave a  $C^{14}$  date of greater than 34,000 yr. On the west side of the pit 10 ft of late Wisconsin till overlies 100 ft of stratified gravel containing clay balls and a few balls of peat or muck. This in turn overlies till considered by the collector to be of Wisconsin age. The measured peat ball came from a depth of 65 ft below the top of the gravel, which is believed by Dreimanis to have been deposited by meltwater from a late Wisconsin ice tongue in the Lake Ontario basin. According to J. Terasmae, who made a pollen analysis showing a tree-pollen assemblage of spruce 70 percent, pine 27 percent, with non-tree pollen 20 to 30 percent (based on total tree pollen 100 percent), the peat accumulated during a climate cooler than the existing climate of the district and records an interstadial or the end or beginning of an interglacial age.

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*St. Pierre-les-Becquets, Quebec (W-189).* A composite section on the south shore of the St. Lawrence River in the vicinity of St. Pierre-les-Becquets, Nicolet County shows two distinctly different till sheets separated by stratified sediments including peat and pieces of wood. No weathering zones are reported from the section. Collected by Nelson R. Gadd, a sample of the wood (Y-242) was sent to the Yale laboratory, but proved to be older than the reach of the method in use at the time of measurement. Accordingly it was forwarded to Washington for measurement, where its age was determined to be greater than 35,000 yr. One glacial advance postdating the peat can be inferred.

*Hillsborough, Nova Scotia (W-157).* A section broadly similar to the preceding one is exposed near Hillsborough Church, near Mabou, Cape Breton Island. Measured in 1952 by L. R. Wilson, the section consists, in brief, of two till sheets separated by marine clay and other stratified material including a layer of peat with imbedded spruce logs. The section as recorded includes no evidence of weathering intervals. Preliminary pollen-and-spore sampling of the basal part of the peat layer by Wilson revealed spruce and fir with subordinate ferns, fungi, and mosses. A piece of one of the spruce logs (Y-232) submitted to the Yale laboratory proved to be older than 21,000 yr and was transmitted to Washington where it was measured with a resulting date of older than 38,000 yr. The youngest drift sheet in Nova Scotia has been considered to be not younger than Cary in age; data upon which a more definite correlation might be based are lacking.

Whether the samples constituting the old group represent an interstadial zone within the Wisconsin stage, dating back to a time outside the present range of  $C^{14}$  measurement, cannot be said with certainty at present. Together with the evidence from Sidney, Ohio (W-188), the ages of the samples in the old group appear to indicate an early Wisconsin glaciation, older than any recognized in Illinois so far, and separated from the later glaciation by an indefinite period of time.

*Godarville, Belgium (W-173).* Just as the European sample from Poggewisch (W-93) fits into the young group described in this article, so another European sample, W-173, belongs with the older group of American samples. In response to a request for samples having known stratigraphic relationships to the Fourth Glacial loess sequence in Belgium, Jean de Heinzelin assembled a group, one of which, collected by De Heinzelin and Roger Vanhoorne in 1953, is from a lens of peat 6 ft below the base of Younger Loess II (Loess récent II) in a canal excavation at Godarville, between Mons and Namur. Zones of frost-disturbed sediment intervene between peat and overlying loess, and also between the peat and an underlying occupation site with Moustierian culture, mammoth, and rhinoceros. The  $C^{14}$  date of the peat, which antedates Younger Loess II, is older than 36,000 yr. Unfortunately the relationship of the peat to Younger Loess I is unknown because that loess is not present in the Godarville section.

### Summary of Inferences

1) A group of samples from horizons previously correlated with the upper part of the Cary substage confirms the correlation as reasonable and is consistently related in time to the dates of the peat layer at Two Creeks and subsequent Mankato events.

2) A major glaciation affected the Great Lakes region beginning 25,000 or more yr ago and reaching its maximum extent about 18,000 yr ago. It is represented by drift correlated in Ohio with the Cary substage and, at least in part, with the Tazewell substage; in Illinois and adjacent states it is correlated with most of the Tazewell substage and with the Farmdale loess.

3) The ecology and other associations implied by the dated samples are more consistent with glacial than with nonglacial conditions.

4) The lower till at Sidney, Ohio (W-188), on which is developed a soil considered a correlative of the Fox series soil on gravels and also buried by till of the major glaciation of 25,000 to 18,000 yr ago, indicates an earlier glaciation extensively exposed in Ohio and believed to be an early Wisconsin event.

Table 2. List of samples and dates arranged by age groups.

Sample No.	Locality	$C^{14}$ age (yr)
<i>Young group samples</i>		
C-596	Cook Quarry, Story Co., Iowa	11,952 $\pm$ 500
C-912	Lizard Creek, Webster Co., Iowa	12,120 $\pm$ 530
C-653	Cook Quarry, Story Co., Iowa	12,200 $\pm$ 500
W-161	Dyer, Ind.	12,200 $\pm$ 350
W-58	Avilla, Noble Co., Ind.	12,380 $\pm$ 360
W-140	Dyer Spit, Ind.	12,650 $\pm$ 350
W-46	Durham Meadows, Conn.	12,700 $\pm$ 280
W-65	Fremont, Steuben Co., Ind.	13,020 $\pm$ 400
W-64	Laketown, Wabash Co., Ind.	13,140 $\pm$ 400
C-913	Lizard Creek, Webster Co., Iowa	13,300 $\pm$ 900
W-83	Lake Arkona, Cleveland, Ohio	13,600 $\pm$ 500
C-664	Cook Quarry, Story Co., Iowa	14,042 $\pm$ 1000
W-198	Edon, Ohio	14,300 $\pm$ 450
W-153	Clear Creek, Story Co., Iowa	14,700 $\pm$ 400
W-93	Poggewisch, Holstein, Germany	15,150 $\pm$ 350
W-126	Mitchellville, Polk Co., Iowa	16,720 $\pm$ 600
<i>Middle group samples</i>		
W-91	Chillicothe, Ohio	18,050 $\pm$ 400
W-187	Farmdale Dam, Ill.	19,200 $\pm$ 700
W-165	Greencastle, Ind.	19,500 $\pm$ 800
W-92	Oxford, Ohio	19,980 $\pm$ 500
W-37	Dayton, Ohio	20,700 $\pm$ 600
W-88	Newark, Ohio	21,400 $\pm$ 600
W-127	Harrisburg, Ohio	21,600 $\pm$ 1000
W-68	Farm Creek, Ill.	22,900 $\pm$ 900
W-188	Sidney, Ohio	23,000 $\pm$ 800
W-66	Bridgeville, Pa.	23,000 $\pm$ 800
W-151	Abri Pataud, Les Eyzies, France	23,600 $\pm$ 800
W-191	Abri Pataud, Les Eyzies, France	24,000 $\pm$ 1000
W-79	Wedron, Ill.	24,000 $\pm$ 700
W-141	Hancock, Iowa	24,500 $\pm$ 800
W-71	Cleveland, Ohio	24,600 $\pm$ 800
W-69	Farm Creek, Ill.	25,100 $\pm$ 800
W-177	Plum Point, Ontario	27,500 $\pm$ 1200

Sample No.	Locality	C <sup>14</sup> age (yr)
<i>Old group samples</i>		
W-67	Lake Bloomington Spillway, Ill.	> 34,000
W-87	Otto, Pa.	> 35,000
W-96	Germantown, Ohio	> 34,000
W-99	Redwood Falls, Minn.	> 31,000
W-100	Port Talbot, Ontario	> 32,000
W-101	Ironton, Minn.	> 32,000
W-102	Bronson, Minn.	> 36,000
W-115	Brookings, S.D.	> 30,000
W-121	Toronto, Ontario	> 30,000
W-139	Independence, Iowa	> 38,000
W-152	North Hampton, Ohio	> 39,000
W-157	Hillsborough, Nova Scotia	> 40,000
W-173	Godarville, Belgium	> 36,000
W-186	Lake Bloomington Spillway, Ill.	31,000 or older
W-189	St. Pierre-les-Becquets, Quebec	> 40,000
W-194	Amber, Ontario	> 34,000

5) An earlier glaciation, or glaciations, is implied at several localities by peat, gyttja, or wood more than 30,000 yr old, overlain by till.

6) The time interval between the middle group and the old group of samples, which has been determined within conservative radiocarbon limits to be greater than 3000 yr, is possibly of the order of 16,000 yr, as suggested by the depth of leaching at Sidney, Ohio. (The ages of all the samples discussed are listed in Table 2.)

7) An attempt should now be made to fix more closely the dates of the old samples and to reexamine in the field the stratigraphic sequence in the light of the radiocarbon dates discussed.

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## Calvin Perry Stone, Investigator and Teacher

BORN in 1892 in Portland, Indiana, Calvin Perry Stone was educated at Valparaiso University, Indiana University, and the University of Minnesota. He began his career as a high school principal and superintendent. After receiving his master's degree in 1916, he became director of research of the psychology laboratory of the Indiana Reformatory. During World War I he served in the U.S. Army as a Medical Corps lieu-

tenant, then as a captain, and was assigned for a period as a psychological examiner. After the war he was appointed instructor of psychology and histology at the University of Minnesota. In 1922 he became assistant professor of psychology at Stanford University. Promoted to associate professor in 1925 and professor in 1929, Dr. Stone served Stanford University almost continuously for 32 years.

Characteristically, Dr. Stone continued to study

and learn throughout his life. He even used his leaves of absence for more intensive research and study. Once during the academic year 1928-29 he conducted investigations on wildness in rats at the Institute for Juvenile Research; and in 1945 he worked at the New York Psychiatric Institute. Furthermore, few scholars in modern psychology have pursued research so consistently, determinately, and productively as did Calvin Perry Stone.

Regularly year after year he published sound and solid reports of meticulously conducted research in his field of major interest, comparative psychology. His secondary field was abnormal psychology. He was an authority in comparative psychology, and an anchorage for many young investigators in this fluid developing branch of the science of behavior.

Calvin P. Stone was not deflected from his persistent search by the fads and fashions in science; the direction of his work was steady through waves of conflicting theories; he always kept his professional goal, collecting the evidence, clearly in mind.

During the 1920's Dr. Stone steadily pursued investigations of the genetic-organic, endocrine, and neural determinants of "congenital" sexual behavior. Neither the anti-instinct movement, nor Gestalt theories, nor conditioned reflex theories and methods deterred him from his intent to learn the facts about animal behavior. He was one of the pioneer American investigators of sexual behavior during a period when the rising curtain of restrictions on studies of sexual functions and behavior still involved some stigma as well as risks to social-professional status.

Generally, Dr. Stone contributed importantly to the laying of the foundations of the study of motivation in sound bodies of evidence. In addition, he contributed to the experimental literature of learning, especially to the study of the organic factors related to learning. In these and other areas he developed and improved methods for the investigation of animal behavior.

As in research, also in teaching, Dr. Stone made

consistent contributions to the intellectual development of thousands of undergraduate and dozens of graduate students at Stanford University. His courses were filled solidly with organized facts, closely based on carefully selected literature, and continuously revised and kept abreast of developments in the particular subjects of instruction. He expected of his students, as he did of himself, sound achievements. His rather formal bearing often, upon close acquaintance, changed to a deep sympathetic personal interest in students as individuals. He inspired unqualified confidence and deep respect in his students as well as in his professional colleagues.

Calvin Perry Stone made important and lasting contributions to the profession of psychology, and indeed, to other related life sciences. He served on planning committees of the American Psychological Association and helped shape its future. Generally he worked effectively for many improvements of the profession. He held important offices in his professional organizations. Most significantly he was elected president of the Western Psychological Association for 1931-32 and president of the American Psychological Association in 1941-42. He was duly honored by membership in the California Academy of Sciences and the National Academy of Sciences.

Dr. Stone served as editor of the *Journal of Comparative and Physiological Psychology* from 1947 to 1950. He edited a standard text in comparative psychology. Beginning in 1948 he was the principal editor of the *Annual Review of Psychology*.

Calvin Perry Stone was a living model of industry, integrity, and determination. Likewise he was a model investigator, teacher, editor, and professional leader. His exemplary achievements will long endure and serve as challenges in the future, as they have in the past, to maturing men and women in psychology and the related sciences.

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## News and Notes

### International Arid Lands Meetings

One-third of the world's land area is arid or semi-arid. Since arid regions are found in every major land mass of the earth, their fuller utilization is a problem of international concern. This aspect was evident in the International Arid Lands Meetings held at Albuquerque, N.M., 26-28 Apr. The meetings were sponsored by the American Association for the Advancement of Science and its Southwestern and Rocky Mountain Division. As one aspect of its international interests, UNESCO several years ago appointed an Advisory Committee on Arid Zone Research. This committee and interested groups in some of UNESCO's member states have sponsored a series

of conferences on different aspects of arid-land study and utilization. The Albuquerque meeting was the most recent in this series.

For two days and three evenings several hundred persons listened to papers presented by experts from Tunis, Sweden, India, Brazil, Mexico, Australia, England, Italy, the Netherlands, Egypt, Israel, and the United States. The audience included not only scientists and engineers but also ranchers and others from the American Southwest to whom the problems of arid-land utilization are personal and pressing.

Discussions were focused on such questions as: How predictable is precipitation in an arid region? How can production be increased from existing water

supplies? How can usable water resources be increased? How practical is it to demineralize saline water? to reuse waste water? What screening procedures would lead to the selection of more productive plant and animal species for arid regions? What are the prospects of increasing drouth resistance through genetic research?

The participants had a dual interest, for, in addition to the purely scientific problems that were discussed, there were frequent reminders that the current explosive increase of the world's population will require the utilization of arid regions to supply man's food needs.

In the opening address Homer L. Shantz reviewed the methods of adaptation to arid conditions that have been developed by plants and animals, primitive and ancient man, and modern man. Neither the problems nor the available methods are strictly comparable, yet modern man might profitably emulate adjustments found satisfactory under natural or primitive conditions. Some plants become dormant during drouth periods and resume normal growth and reproduction during more favorable conditions. Some animals, notably the camel, possess exceptional tolerance to dehydration. Either through genetic change or through careful selection of existing species, can man capitalize on such adaptations in making arid lands more productive? Shantz concluded that physiologists and geneticists have a rich opportunity for scientifically important and socially useful study of such problems.

Edward G. Bowen of Australia described measurements showing the relationship between rainfall and the presence of meteoritic dust in the earth's atmosphere. Passage of the earth through a shower of meteoritic dust seems to be followed by an increase in precipitation that occurs nearly simultaneously all over the globe. Such a relationship appears in the year-after-year precipitation records of widely scattered observation posts and can hardly be attributed to purely local climatic conditions. Perhaps this cosmic cloud seeding will add an important new element to the prediction of weather conditions.

In one of the most provocative papers, Louis Koenig, vice president of the Southwest Research Institute at San Antonio, Tex., discussed the economics of water resources. Water can be diverted from its normal course to regions of greater need; there are possibilities of inducing artificial precipitation; sea water and brackish water can—by distillation or other means—be made usable for industrial and agricultural purposes and, sometimes, for human consumption; waste water can be reused, as it is in many communities and plants. But all these possibilities raise major economic problems: the cost of production and the cost of transportation to the point of use. Koenig cited an estimate that by the year 2000 South Texas will be able to use 12.3 million acre-feet of water a year. In terms of tonnage, this amount of water is 40 times the nation's petroleum production, or 400 times its chemical production.

Since an acre-foot of water in the United States will support about 60 times as many workers in industry as it will in agriculture, Koenig reported, it seems reasonable to suggest a sharp reversal of historic trends in land utilization: let the humid regions grow food while the arid regions are used for industry.

In the final session—which, like the other evening meetings, was an open session with the public invited—B. T. Dickson, the retired chief of the division of plant industry of the Commonwealth Scientific and Industrial Research Organization at Canberra, Australia, reviewed some of the highlights of the earlier discussion and described some of the challenges of arid-land research and development for the benefit of mankind.

Obviously it is impossible to report here all 31 papers. They constitute a major review of current information on research problems of arid regions and will probably be published in book form, together with a summary of the discussions that took place 2-4 May at Socorro, N.M., where the speakers and a selected group of other participants were brought together for a consideration of research problems.

The International Arid Lands Meetings were supported financially by the National Science Foundation, the Rockefeller Foundation, and UNESCO. The University of New Mexico and the New Mexico Institute of Mining and Technology served as hosts. A committee of the Southwestern and Rocky Mountain Division of the AAAS, under the chairmanship of Peter C. Duisberg, made the local arrangements. General conference planning was under the direction of a AAAS committee of which Gilbert White was chairman.

It is too early to evaluate such a meeting in all its effects and implications, but on-the-spot reactions seemed to justify the hope that it will prove to be scientifically stimulating. There is, however, a danger in holding discussions of such problems in a setting that constantly reminds one of their pressing economic and social importance; too much may be expected too quickly. In remarks at the opening session, Elvin C. Stakman reminded the audience—and the residents of arid regions—that wise words are not enough. Better utilization of the arid regions of the world will require wise political and economic actions to take advantage of scientific findings—and will also require time.

## Science News

The National Science Foundation has announced plans for a survey of expenditures for scientific research and activities in more than 1000 American universities and colleges. Alan T. Waterman, director of the foundation, announced that the institutions are being asked to provide the following information: total annual expenditures for research; sources of funds; subject fields in which research is conducted; and the number of scientists on the staff—both faculty

members and researchers—and the extent to which these scientists are engaged in research.

In a letter to the presidents of the institutions, Waterman urged for full cooperation and said:

... The findings should be valuable to universities and colleges in planning and appraising their own research efforts in addition to contributing significantly to the formulation of sound national policies for the strengthening of scientific research and education.

Previous estimates by the NSF indicated that total Federal support of research at educational institutions amounts to about \$300 million annually. About \$150 million of this total is spent in special-purpose research centers managed by the universities for various Federal agencies. The institutions themselves contribute an estimated \$20 million to \$100 million annually and an additional sizeable amount is received from industry, foundations, and other private groups.

It is expected that the new survey will provide more accurate estimates of the total research expenditures and of the amounts contributed by each source. It will also be possible to estimate the research contributions made indirectly by the institutions. These include payment of staff salaries, provision of facilities, and administrative and other nonitemized expenses. The survey will also give needed information on the distribution of scientists in the nation's higher educational institutions and indicate the extent to which competent scientists are now engaged in research.

A suggestion that sea urchins be stored in winter in order that sufficient numbers of them may be available for summer research projects has been put forth by John S. Rankin, Jr., associate professor of zoology at the University of Connecticut. Rankin has been studying the problem of the distribution of ocean-bottom animals for the past four summers at Woods Hole, Mass., and in nearby coastal waters. For more than 50 years, scientists have been able to find enough marine animals for research purposes, but recently certain species have disappeared and others have decreased in number. Especially mystifying is the disappearance from its former beds of the purple sea urchin *Arbacia punctulata*.

Rankin has advanced several theories for the cause of disappearance: hard winters and line storms, or hurricanes, which cause a change in topography, and the preying of starfish. Old age and overcollection may also have contributed to the urchin's disappearance. Rankin presented his findings and recommendations at the International Conference on Marine Biological Laboratories that met in Rome, Italy, 18-22 Apr.

The cost to the farmer of the damage done by diseases, insects and weeds is 30 times that of the price he pays each year for chemical controls. The \$7.5 billion of damage done annually is in marked contrast to the \$241 million spent annually to curb or combat the damage.

The U.S. Department of Agriculture compiled these figures from a nationwide survey in which more

than 23,000 farmers cooperated. The survey also showed that only one-sixth of the nation's cropland is treated and that potatoes get more treatments than any other crop, namely, five per season.

Other data compiled by the department's survey revealed the following: (i) farmers treated as many acres for weed control as they did for both insects and diseases, duplication being found in less than 3 million of the treated acres; (ii) farmers do their own spraying; (iii) the frequency of chemical use varies with the purpose, crops, and other factors, but, nationally, one application per season is made for weed control and three are made for insects and diseases. A full report of the survey is carried in the April 1955 issue of the department's journal, *Agricultural Research*.

Additional facts about a "supercirculation" system for airplanes were released by Joseph Flatt of the Wright Air Development Center, Dayton, Ohio, at the meeting of the Society of Automotive Engineers in Washington, D.C., on 20 Apr.

The "supercirculation" or "boundary layer control," as it is also known, is considered a revolutionary development in air operations. It involves blowing an extra stream of high-speed air over the surface of a wing or inhaling the normal flow into the wing. In either case, the action increases lift and lowers a plane's take-off and landing speeds.

Flatt disclosed that flight tests with a Fairchild C-123 started 7 Dec. 1954 had been "very encouraging." He said that it was estimated that, when the installation has been perfected, the gross-weight take-off distance of the plane would be reduced from 1950 to 850 ft and the landing distance reduced from 1200 to 775 ft. Flatt also disclosed that successful tests have been made with the new development on a North American F-86 Sabre. Stalling speed was cut from 114 to 88 knots.

Organizations and individuals may be given access to nonmilitary confidential and secret restricted data on atomic energy technology for their own private purposes. This was announced under a new program of the U.S. Atomic Energy Commission.

Confidential, restricted atomic data may be made available to any person who can evidence a potential use or application of the information in his business, profession, or trade. The person must also obtain a simplified security clearance and agree in writing to conform with all AEC security regulations. The Government will waive all rights in inventions and discoveries arising out of access to such information. When an invention or discovery is made or conceived as the result of access under this program the applicant will waive potential claims against the Government arising from the imposition of secrecy orders on patent applications and for awards under the Atomic Energy Act of 1954.

Limited access to secret, restricted data may also be granted if the applicant can demonstrate that such information has an immediate and significant effect on

his business, profession, or trade. In this case, however, the applicant must obtain a full security clearance and the Government will retain royalty-free nonexclusive rights for governmental purposes in inventions and discoveries which result from such access.

All such persons or groups given access to restricted data will also be required to reimburse the Government for any costs incurred in making access available.

The Metropolitan Life Insurance Company reports new data on current trends in mortality from **leukemia**. According to the company's study, there has been a slight decline in the death rate from the disease among the company's industrial policyholders since 1951. Leukemia, a malignancy involving the blood and blood-forming organs, is now responsible for more than 10,000 deaths a year in the United States. This is about twice the mortality from cancer of the mouth and three times that from skin cancer.

Dairy scientists at the Agricultural Research Center, Beltsville, Md., have found that counting microbes in forage plants in field and silo has assisted them in learning more about what makes **good silage**. They have found that bacteria, yeasts, and molds on plants in the field generally become more numerous as the growing season advances. Most microorganisms in fresh-cut forage are aerobic. Anaerobic microorganisms are much less numerous. Good silage seems to depend on maintaining conditions favorable to the lactic-acid-producing bacteria; the large numbers of aerobic microbes naturally present in forage may help. Abundant natural sugars in plants also encourage desirable bacteria, although some valued forage crops such as alfalfa are low in sugar.

A series of 33 colorful exhibits interpreting life among the historic Indian tribes of the Southwest and California has been opened in the Natural History Building of the U.S. National Museum. Included in the exhibits are five groups of life-sized, authentically-costumed Indian figures engaged in typical tribal activities. Several of the many wall-case exhibits are devoted to the crafts in which Indians were particularly skilled, and others point out such aspects of Indian life as the great variety of foods eaten by California tribes, the use of shell money, and the Hopi Indian kachina dolls that served to teach children to recognize their tribal gods.

The new exhibits, which were prepared as part of the Smithsonian Institution's large-scale program for modernizing its museum exhibits, were designed and installed under the direction of John Anglim, exhibits specialist, and John C. Ewers, associate curator of ethnology at the Institution.

Smog was described as the greatest single cause of lung cancer by Paul Kotin, University of Southern California pathologist, on 19 Apr. at the 3rd National Air Pollution Symposium in Pasadena, Calif. Kotin and a research team have conducted experiments for more than 4 years with thousands of animals, under a

U. S. Public Health Service grant at the U.S.C. Medical School and the Los Angeles County General Hospital. The animals were subjected to artificial smog created by gasoline vapors and fumes from gasoline and diesel engines.

Kotin said that the study showed that smog "has a prolonged accumulative effect" as a tumor inducer. He explained that the pollutant which is the irritant causing the cancer is at least one type of hydrocarbon in the oxidized state. Further experiments are planned to detect which hydrocarbon is actually the cause and what chemical state it is in when it does its damage. Kotin also announced that he and his coworkers could not find smog to be otherwise deleterious to health—that is, no consistent biological changes in the respiratory systems of the test animals were found.

## Scientists in the News

**Charles W. Arnold**, research engineer for the Humble Oil Co. at Houston, Tex., has received the first Phi Lambda Upsilon national award, which consists of a certificate and \$500. He was honored for his thermodynamic and spectroscopic study of ethylene oxide. The P.L.U. award will be made annually to a candidate in chemistry, chemical engineering, or allied fields who has been granted his doctoral degree by a U.S. college or university during the previous academic year. Qualities of originality, professional ability, theoretical and practical reasoning skill, and research leadership, as evidenced in the doctoral thesis, are considered in selection of the recipient. Eligibility is not restricted to members of P.L.U.

**John W. Mitchell** of the University of Bristol, England, presented a series of four lectures on the photographic processes in the silver halides before the chemistry department of Ohio State University on 7, 8, and 9 April. The lectures were entitled: "The physical properties of the silver halides"; "The chemical sensitization of crystals of silver halides for the formation of a surface latent image"; "The formation and the development of the photographic latent image"; and "The interpretation of different latent image effects."

**Anton J. Carlson** was unanimously elected to the specially created post of honorary president for life of the National Society for Medical Research at the society's annual meeting on 6 Feb. in Chicago. Carlson, who had been president of the NSMR since its inception in 1946, turned the active leadership of the society over to Lester R. Dragstedt, chairman of the department of surgery at the University of Chicago. Spontaneous expressions of appreciation for Carlson's work on behalf of all research biologists came from several members of the NSMR board. The Mar.-Apr. issue of the society's journal, the *Bulletin for Medical Research*, states:

Dr. Carlson's head-on approach to this delicate, emotion-laden matter has not only stopped the anti-vivisection tide but decisively turned it back. For

more than six years all legislative developments, all court decisions, all the administrative decisions of state and municipal officials have been favorable to medical research.

In addition to Dragstedt, Maurice Visscher, chairman of the department of physiology at the University of Minnesota Medical School, was elected vice-president, and Ralph Gerard, director of research at Illinois Neuropsychiatric Institute, continued in office as secretary-treasurer. All other members of the board were reelected unanimously.

Two individuals were voted special citations in recognition of their efforts on behalf of medical research during the past year. The two men honored were **Albert H. MacCarthy**, president of the Anne Arundel County (Md.) S.P.C.A. and **Charles W. Morgan**, chairman of the department of physiology at Georgetown School of Medicine, Washington, D.C. MacCarthy, a long-time humane leader, was responsible for the scheduling of a tour of the animal research laboratories at Emory University as part of the annual convention of the American Humane Association in Atlanta last year. Morgan was cited for his splendid work in spearheading the successful campaign to make unclaimed pound animals available to research institutions in the Washington area. The ruling by the Commissioners of the District last February was the most important legislative victory of the year.

**Nisson A. Finkelstein**, head of the special research and lens design department of the Scientific Bureau of Bausch and Lomb Optical Co., has been appointed assistant to the bureau's director. His new responsibilities will include direction of all basic research on projects not directly related to product development.

**J. Earl Thomas, Jr.**, assistant professor of electrical engineering at Massachusetts Institute of Technology, has been named chairman of the physics department at Wayne University. He will assume his new duties in September.

On 14 Apr. **Jerome C. Hunsaker**, chairman of the National Advisory Committee for Aeronautics since 1941, received the Langley gold medal of the Smithsonian Institution for his accomplishments in the field of aeronautical engineering. Only eight other men of aviation have been so honored in the 46-year history of the medal. In the citation, Hunsaker's outstanding achievements as director of the NACA program were stressed.

**Walter Wilbrandt** of the department of pharmacology, University of Berne, Switzerland, will spend this summer at the Marine Biological Laboratory, Woods Hole, Mass. as senior Lalor fellow. Junior Lalor fellows who will also be at the laboratory include: **Roderick Keener Clayton**, department of physics, U.S. Naval Postgraduate School, Monterey, Calif.; **Howard Gest**, department of microbiology, Western Reserve University School of Medicine, Cleveland, Ohio; **Maurice Green**, Children's Hospital, Philadelphia, Pa.; **Ralph**

**Arnold Lewin**, National Research Council, Halifax, Nova Scotia, Canada; **Italo Alden Macchi**, Clark University, Worcester, Mass.; **Jay S. Roth**, Hahnemann Medical School, Philadelphia, Pa.

The bicentennial medal of the City College of New York Chemistry Alumni Association will be awarded to **Peter Debye**, Nobel laureate, on 20 May in the college's department of chemistry. Debye will lecture on "The use of radiation in structural analysis."

**Charles S. Draper**, head of the department of aeronautical engineering at Massachusetts Institute of Technology, will deliver the 43rd distinguished Wilbur Wright memorial lecture in London, England, on 19 May. He will speak on "Flight control," discussing the subject from its beginnings in historical aircraft to its use in the high-performance systems of today. Trends in both theory and practice will be described as parallel streams of development.

**Leo Finzi**, authority on magnetic amplifiers and electrical machinery, has been named Buhl professor of electrical engineering at Carnegie Institute of Technology, where he has been faculty member since 1946. As Buhl professor, Finzi will work to develop research leadership in the graduate electrical engineering program. He succeeds **B. R. Tear**, who has relinquished the chair because of the weight of his responsibilities as dean of the College of Engineering and Science.

**Robert N. Colwell**, associate professor of forestry at the University of California, Berkeley, is the recipient of the 1954 Talbert Abrams award of the American Society of Photogrammetry. The award is given annually for the best published article on photogrammetry. Colwell's article, "A systematic analysis of some factors affecting photographic interpretation," appeared in the June 1954 issue of *Photogrammetric Engineering*. One of the pioneers in photogrammetry, Colwell served in the U.S. Navy during World War II, studying aerial photographs to detect enemy activity behind camouflage and to determine the suitability of terrain for amphibious invasion. He is now working to perfect photogrammetry as a means of detecting the height, volume, density, and species of timber stands from aerial photographs.

**Walter R. Miles**, professor emeritus of psychology at Yale University, since Nov. 1954 has been professor of experimental psychology at the University of Istanbul, Turkey. In a recent public lecture in that city, Miles spoke on "Psychology in the service of the community and the state."

**Richard H. Orr**, formerly a research physician at the Metabolic Unit for Research in Arthritis and Metabolic Diseases, University of California Medical Center, San Francisco, has been appointed medical director of Grune & Stratton, Inc., a New York publishing house dealing exclusively in medical books and journals.

The appointment of **Harry M. Weaver** as administrator for research has been announced by the American Cancer Society. From 1946 to 1953, Weaver was director of research for the National Foundation of Infantile Paralysis. Since joining the Cancer Society as a special research consultant last year, he has been working on an extensive and comprehensive survey of cancer research in the United States. In his new post, Weaver will direct the society's broad research program, which supports the work of more than 1000 scientists in 132 research institutions.

**Robert S. Mulliken**, professor of physics at the University of Chicago and newly appointed science attaché at the American Embassy in London, represented the National Academy of Sciences at the celebration commemorating the 100th anniversary of the death of the illustrious mathematician and physicist, Karl Friedrich Gauss, held at the University of Göttingen on 19 Feb. Mulliken, on behalf of the National Academy, conveyed greetings from president Detlev W. Bronk to the university and to the Academy of Sciences of Göttingen.

The National Science Foundation has established an Office for the International Geophysical Year. The new office will be headed by **J. Wallace Joyce**, who has been a member of the staff of the Assistant Secretary of Defense for Applications Engineering.

## Necrology

**A. I. Abricosov**, 80, pathologist, author, chairman of the Russian Society of Pathologists, Moscow, 11 Apr.; **William R. Allen**, 70, zoologist, former professor, author, curator of the Zoological Museum at the University of Kentucky, Lexington, 7 Apr.; **George O. Altmann**, 37, research physicist with the General Aniline and Film Corp., Linden, N.J., 13 Apr.; **John A. Borneman**, 76, botanist, author, professor emeritus of pharmacy at Hahnemann Medical College, Philadelphia, Pa., 8 Apr.; **Ethel Bowman**, 76, professor emeritus of psychology at Goucher College, Baltimore, Md., 8 Apr.; **Howard C. Carpenter**, 76, former vice dean of pediatrics at the University of Pennsylvania's Graduate School of Medicine, past president of the American Pediatrics Society, 7 Apr.; **Grace E. Davis**, 84, associate professor of physics emeritus at Wellesley College, Wellesley, Mass., 15 Apr.; **Louis Edeiken**, 61, professor of radiology at Hahnemann Medical College, associate in radiology at the University of Pennsylvania's Graduate School of Medicine, attending chief of radiology at the Einstein Center, Southern Division, Philadelphia, 11 Apr.

**Albert Einstein**, 76, theoretical physicist and mathematician, author, professor emeritus at the Institute for Advanced Study in Princeton, N.J., 18 Apr.; **Louis Friedman**, 79, surgeon, author, New York, 9 Apr.; **Martin Gumpert**, 57, gerontologist, dermatologist, author, New York, 18 Apr.; **Frank B. Halford**, 61, airplane engine designer, director of the de Havilland Aircraft Co., London, 17 Apr.; **Louis A. Higley**, 83,

former professor of geology and chemistry, dean emeritus of King's College, New Castle, Del., 12 Apr.; **Marion Hollingsworth**, 77, analytical chemist, assistant professor emeritus of chemistry at the Ohio State University, Columbus, 6 Apr.; **George H. Howe**, 67, author, associate professor of pomology at the New York State Agricultural Experiment Station, Geneva, N.Y., 13 Apr.; **Jean-Paul Jamart**, 60, geologist, retired head of the Prospecting Service of Diamang in Dundo, Angola; **Carl H. Lenhart**, 74, medical researcher, author, former head of the department of surgery at Western Reserve University's Medical School, Cleveland, Ohio, 8 Apr.; **Charles O. Lenz**, 86, consulting engineer in the fields of steam and atomic power, Summit, N.J., 8 Apr.

**Harvey S. Mudd**, 66, mining engineer, former president of the American Institute of Mining and Metallurgical Engineers, Beverly Hills, Calif., 12 Apr.; **Robert D. Pike**, 70, consulting chemical research engineer, New York, 13 Apr.; **Gordon W. Raleigh**, 45, heart and internal medicine specialist, chairman of the graduate education committee of the Northwestern University Medical School, Evanston, Ill., 13 Apr.; **Emil Schwarz**, 89, author, research associate in hematology at Michael Reese Hospital, Chicago, Ill., 2 Apr.; **Palmer Smith**, 63, science writer and editor for the Department of Agriculture, Washington, D.C., 16 Apr.; **Pierre Teilhard de Chardin**, 73, paleoanthropologist, codiscoverer of "the Peking Man," research associate at the Wenner-Gren Foundation for Anthropological Research, New York, 10 Apr.; **Ernest C. White**, 74, inventor of the Duplexalite indirect lighting device, Bronxville, N.Y., 14 Apr.

## Meetings

The Scientific Film Association of England, in co-operation with the International Scientific Film Association, has organized a conference on "Film in the Improvement of Human Relations in Industry," to be held 24-26 May at Ashorne Hill. Application forms and further details may be obtained from the General Secretary, Scientific Film Association, 164 Shaftesbury Ave., London, W.C.2.

"Biogenesis," a symposium on the origin of life, will be held 7 May at the Polytechnic Institute of Brooklyn, under the chairmanship of Harold C. Urey. The following papers will be presented: "The physical basis of the origin of life on planets," by Harold C. Urey, Institute for Nuclear Studies, University of Chicago; "Organic constituents of fossils," by Philip H. Abelson, Geophysical Laboratory, Carnegie Institution of Washington; "Pyrosynthesis of biochemical substances and evolution of protein molecules," by Sidney W. Fox, department of chemistry, Iowa State College; "The origin of the cell," by George Wald, Biological Laboratories, Harvard University; and "Critical resume," by Harold F. Blum, department of biology, Princeton University. Inquiries should be addressed to Kurt G. Stern, Polytechnic Institute of Brooklyn, Brooklyn 1, N.Y.

The American Psychiatric Association will hold its 11th annual meeting at Atlantic City on 9-13 May, with some 3500 psychiatrists and guests expected to attend. The 5-day program will feature the presentation of 118 scientific papers, scientific and commercial exhibits, a closed-circuit television program, mental health films, an open meeting held jointly with the Atlantic County (N.J.) Mental Health Society, and several other special events.

Recent developments on almost every aspect of psychiatry will be discussed by the speakers. Several papers on drug therapies (notably Serpasil and Chlorpromazine) will be of particular interest because of the encouraging results that have been noted thus far from their use in the treatment of psychoses. Among the other topics to be presented are an evaluation of laws on homosexuality; study of children with duodenal ulcer; maintaining mental health in a world of tension; psychodynamics of the "dry drunk"; studies in urban mental health; economic structure of private practice in psychiatry; observations on family attitudes related to hospitalization of schizophrenic patients; the concept of "normality"; psychiatric problems of troops in Korea; and the harmful effects of interpersonal conflicts among flying personnel.

A conference on the use of nuclear radiation to improve potato economy will be held at Brookhaven National Laboratory on 25 May under the auspices of the biology and nuclear engineering departments of the laboratory. Scientists and other representatives of universities, agricultural experiment stations, and commercial organizations will meet to discuss the biological, physical, and industrial aspects of potato irradiation. Speakers actively engaged in research will report on such topics as: effects of nuclear rays and particles on inhibition of growth and sprouting in potatoes; effects on black spot reaction; tolerance of the golden nematode disease to radiation; and wholesomeness and vitamin content of foods exposed to radiation.

Those wishing to attend the conference should notify A. H. Sparrow, Brookhaven National Laboratory, Upton, L.I., N.Y. Noncitizens of the United States should state their nationality. Local overnight accommodations for about 150 guests will be reserved in order of receipt of applications.

The Office of Naval Research and the Navy Electronics Laboratory, San Diego, together with Ryan Aeronautical Co., are cosponsoring a symposium on Normal Mode Theory, 5-7 July. A number of foreign scientists have been invited to participate in this meeting, which will take place in San Diego under the chairmanship of S. A. Schelkunoff of Bell Telephone Laboratories. The group will exchange ideas about the theoretical knowledge of tropospheric wave propagation, the known methods of attack, and the principal unanswered questions. For further information, write to Dr. J. B. Smyth at the U.S. Navy Electronics Laboratory, San Diego 52, Calif.

The 3rd annual Symposium on Antibiotics, sponsored by the U.S. Food and Drug Administration's division of antibiotics and the journals, *Antibiotics and Chemotherapy* and *Antibiotic Medicine*, will be held in Washington 2-4 Nov. Those wishing to participate must submit abstracts in triplicate and no more than 200 words long, before 21 Sept., and the original manuscript and one copy must be received by 3 Oct.

Please note that this schedule is a departure from requirements of the previous symposiums. It will accomplish two objectives: it will allow the program committee to make a better choice of material for presentation, and it will allow earlier publication of the *Antibiotics Annual 1955-56*. For details, write Dr. Henry Welch, Director, Division of Antibiotics, Food and Drug Administration, U.S. Department of Health, Education, and Welfare, Washington 25, D.C.

The annual meetings of the American Society of Agronomy and the Soil Science Society of America will be held 15-19 Aug. at Davis, Calif. An estimated 375 papers will be presented. The programs are open to anyone concerned with crop production and soils problems, and all interested persons are invited to attend.

Both societies consist of professional workers in crops and soils. The combined membership of 2300 includes representatives from commercial and industrial organizations, agricultural colleges, and federal and state agencies. Executive secretary for the two groups is L. G. Monthey, 2702 Monroe St., Madison 5, Wis.

## Society Elections

**Soil Conservation Society of America:** pres., Austin L. Patrick, Washington, D.C.; 1st v. pres., Edward H. Graham, Falls Church, Va.; 2nd v. pres., Robert M. Salter, Silver Springs, Md.; treas., Howard R. Bissland, Orlando, Fla.; exec. sec., H. Wayne Pritchard, 1016 Paramount Building, Des Moines, Ia.; editor, Walter C. Gumbel, Fairmount, W. Va.

**Phycological Society of America:** pres., G. W. Prescott, Michigan State College; v. pres., H. C. Bold, Vanderbilt University; sec., P. C. Silva, University of Illinois; treas., R. D. Wood, University of Rhode Island.

**American Association of Dental Schools:** pres., Harold J. Noyes, Dental School, University of Oregon; pres.-elect, Lee Roy Main, School of Dentistry, St. Louis University; v. pres., Roy G. Ellis, Faculty of Dentistry, University of Toronto; sec.-treas., Marion W. McCrea, Dental School, University of Maryland; editor of *Journal of Dental Education*, Charles W. Craig, College of Dentistry, University of California, San Francisco.

**The American Society of Plant Taxonomists:** pres., Albert C. Smith, Smithsonian Institution, Washington, D.C.; chairman of the Council, David D. Keck, New York Botanical Garden, Bronx Park, New York, N.Y.; sec., Reed C. Rollins, Harvard University;

treas., Richard A. Howard, Harvard University. Representatives to AAAS Council are Albert C. Smith and George L. Church.

**Pennsylvania Academy of Science:** pres., Harry K. Lane, Franklin and Marshall College, Lancaster; pres.-elect, Richmond E. Myers, Moravian College, Bethlehem; v. pres. (east), James A. Fowler, Academy of Natural Sciences, Philadelphia; v. pres. (west), M. Graham Netting, Carnegie Museum, Pittsburgh; sec.-treas., Kenneth N. Dearolf, Public Museum and Art Gallery, Reading.

## Education

**South Dakota State College** has been authorized to offer doctor's degrees in three fields—animal husbandry, agronomy, and agricultural economics. Supporting courses in the animal sciences that will reinforce the degree in animal husbandry are in dairy husbandry, entomology-zoology, poultry husbandry, and veterinary science. Plant science supporting courses for the degree in agronomy are in bacteriology, botany, horticulture, and plant pathology. Social science courses supporting the degree in agricultural economics are in education, history and political science, and rural sociology.

John W. Headley, president of the college, emphasized that this program is being initiated to help combat the disturbing nationwide trend toward fewer graduate students, a trend that could seriously hamper efforts to increase the number of American scientists.

The psychology department of the University of Chicago announces that S. J. Beck will conduct two 1-wk workshops in the Rorschach test 11-22 July. The basic processes in test evaluation will occupy the first week's workshop, which will also demonstrate full test interpretation. The second week will be devoted to problems of advanced clinical interpretation, particularly those exemplified by children in more disturbed states and by adults in milder neurotic conditions.

Workshop I may be taken by students at, or ready for, the intern level. Admission to workshop II is limited to psychologists and psychiatrists in clinical positions or practice. Each seminar will meet for two 2-hr sessions per day. For full information, write to the Executive Secretary, Dept. of Psychology, University of Chicago, 5728 S. Ellis Ave., Chicago 37, Ill.

Four copper-mining companies in northern Rhodesia have announced they will share in providing \$1,120,000 to establish an educational foundation in the copper belt. The plan is to promote technical training among white persons to insure a supply of trained labor for the mines. At present, there are no facilities for such instruction beyond the apprentice stage. Since two new copper mines are being developed and production at the existing mines is being increased, heavy demands are being placed on present trained manpower.

The four contributing companies are the Mufulira

Copper Mines, Ltd., the Nchanga Consolidated Copper Mines, Ltd., the Roan Antelope Copper Mines, Ltd., and the Rhokana Corporation, Ltd.

A course in medical mycology to be offered 5-30 July at Duke University School of Medicine and Duke Hospital will emphasize the clinical, pathologic, and therapeutic aspects of fungous infections. Patients, clinical materials, cultures, and laboratory animals will be available for study. An opportunity to study gross and microscopic pathologic materials will be given to those qualified by interest and previous training. Practical laboratory aids that help to establish a definitive diagnosis will be stressed. The course is open to clinicians, pathologists, bacteriologists, technicians, and others who have an interest in the medical phases of mycology. Classes will meet 6 days a week. Inquiries should be directed to Norman F. Conant, Duke Hospital, Durham, N.C.

Mamacoke Island, a 40-acre rocky and wooded peninsula rising 200 ft above the Thames River near New London, Conn., was purchased for a total price of \$15,000 on 14 March 1955, to add to the Connecticut Arboretum at Connecticut College.

Richard H. Goodwin, director of the Connecticut Arboretum, reported that 26 organizations and 210 individuals made contributions ranging from \$1 to \$2000 since the effort to preserve the island got underway 26 Aug. 1954. The adjacent shoreline already is part of the arboretum, which now totals 300 acres. The island, uninhabited and undeveloped since Indian times, will be kept essentially in its natural state, with road construction forbidden.

The Polytechnic Institute of Brooklyn has announced its 12th annual series of summer laboratory courses, 6-17 June. These intensive 1- and 2-week courses were instituted in 1944 as an experimental program for teaching modern laboratory techniques to meet the growing demand by scientists, particularly industrial scientists, for advanced instruction in the use of specialized physical tools in chemistry and physics. For information write Mrs. Doris Cattell, Secretary, Summer Laboratory Courses, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N.Y.

An estimated 1000 men and women of science, representing seven professional societies, participated in Morgan State College's dedication of its new \$1.5 million science facilities, 13-17 Apr. The dedication brought together for their annual meetings the Beta Kappa Chi Scientific Society and the National Institute of Science. Also holding sectional meetings on the college campus during the dedication week were the Maryland Section of the American Chemical Society; the Maryland, Delaware, Virginia, and District of Columbia Section of the Mathematics Association of America; the Maryland Association of Biology Teachers; the American Association of Physics Teachers; and the Maryland Science Teachers Association.

Alan T. Waterman, director of the National Sci-

ence Foundation, spoke during the dedication ceremony on "Research and education in the sciences." Others who delivered addresses were J. Ernest Wilkins, Jr., mathematician of Nuclear Development Associates, Inc., White Plains, N.Y.; Percy L. Julian, research chemist and founder-director of the Julian Laboratories, Inc., Franklin Park, Ill.; Gaylord P. Harnwell, president of the University of Pennsylvania; Fletcher G. Watson of the Graduate School of Education, Harvard University; and Lynn Poole, director of the "Johns Hopkins Science Review."

Facilities in what is known as the "science quadrangle" that were dedicated included the Milton Lewis Calloway Science Hall, a \$1,300,000 structure completed in early September and used for instruction in the sciences for the first time this year. Named in honor of the late Milton L. Calloway, pioneer science teacher at the college, the building has 17 laboratories for work in nuclear physics, radiation, electronics, optics, and so forth. There are six lecture rooms and a 300-seat amphitheatre.

Spencer Hall and the Vivarium, both for biology, and Carnegie Hall for psychology, are other facilities that were dedicated. Spencer and Carnegie Halls have just been remodeled. Martin N. Jenkins, president of the college, noted that with the development of the science quadrangle the college has for the first time "adequate facilities in the natural sciences."

The University of Tennessee is offering a course in radioactivity for secondary-school science teaching, 18-29 July. For information, write to W. W. Wyatt, College of Education, University of Tennessee, Knoxville.

## Grants, Fellowships, and Awards

Medical research grants have been awarded 40 clinicians and laboratory workers under the grants-in-aid program of the National Tuberculosis Association. The grants total approximately \$200,000, which were derived from the percentage of Christmas-seal funds allotted to the N.T.A. by affiliated associations throughout the country. Additional amounts are being contributed to research by a number of state and local tuberculosis associations.

The subjects under study reflect the changing picture in tuberculosis and the new problems that have arisen as a result of new methods of treatment. One group of investigators is trying to determine the whole course of events when an antituberculosis drug is taken by a patient; another group is studying the effect of surgery on the capacity of the patient to breathe; others are studying possible factors responsible for enhancing resistance to tuberculosis, and still others are pursuing basic studies on the tubercle bacillus, its virulence and behavior under various circumstances.

To encourage research training of promising young scientists and engineers, the Eastman Kodak Co. will award 34 fellowships, valued at more than \$100,000,

for advanced study in physics, chemistry, and chemical engineering for the academic year 1955-56. Each fellowship grant provides at least \$1400, with an additional \$1000 being paid to the participating university to help defray the cost of research expenses during the fellowship period. Every recipient will have the opportunity to attend one important scientific or professional meeting appropriate to his field of study.

Under the program, initiated by Kodak in 1939, the 34 fellowships are awarded to a corresponding number of colleges and universities in the United States and Canada. Each institution receiving a grant selects the recipient on the bases of demonstrated ability in his major field of study, a high degree of scientific or engineering promise, and financial need, with preference being given to students in the last year of study for the Ph.D. degree.

The Radio Corporation of America has announced six fellowship awards. These grants range from \$1800 to \$2700, part of which is specified for tuition and university fees. The purpose of the fellowships is to provide assistance for predoctoral graduate students, at designated universities, who display outstanding ability in fields of study related to radio, television, and electronics. More than 70 men have received RCA fellowships since 1947, when the awards were first inaugurated.

The American Society of Mechanical Engineers will administer a fund that has been established to support the new Elmer A. Sperry award. This award—made possible by Dr. Sperry's daughter Helen (Mrs. Robert Brooke Lea) and his son, Elmer A. Sperry, Jr.—will be bestowed in recognition of "a distinguished engineering contribution which through application, proved in actual service, has advanced the art of transportation whether by land, sea or air."

The award may be made to an individual or to a group of individuals; it is believed that this is the first major engineering award to recognize group effort. The winner will be chosen by a board made up of representatives from the ASME, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers.

The first award, which will be conferred this fall during ASME's Diamond Jubilee Annual Meeting in Chicago, will consist of a bronze medal, a certificate, a bound copy of the biography of Elmer A. Sperry by Jerome C. Hunsaker, and an honorarium.

## In the Laboratories

Minneapolis-Honeywell Regulator Co. and Raytheon Manufacturing Co. will collaborate in engineering and marketing high-speed electronic data-processing systems for use in business and government. The project will be carried out through the formation of a jointly-owned corporation, to be known as Datamatic Corp. With headquarters in Waltham, Mass., the new firm will have its own administrative officers and directors.

Latest addition to the International Nickel Co.'s Bayonne Research Laboratory is a new plating laboratory, the main feature of which is a fully automatic pilot plating plant that permits the testing of new plating processes and metallic coatings under conditions virtually similar to those existing in actual industrial plating plants. In cooperation with container manufacturers and their suppliers of can stock, research into the merits of thin nickel plating for can coatings is now in progress at the laboratory.

The purchase of a tract of land at Omaha, Neb., has been announced by the Stauffer Chemical Co. Approximately 15 acres will be used in 1955 for the construction of an agricultural chemical plant for the manufacture of dust and liquid insecticides, herbicides, and grain fumigants. Present plans also include the construction of a large warehouse to handle the complete line of Stauffer agricultural chemicals.

An Academy Award "Oscar" was presented at the annual award ceremonies on 30 Mar. to the Bausch & Lomb Optical Co. for its scientific contributions to the motion picture industry, and particularly for its achievement in producing the CinemaScope camera and projection lenses.

## Instruments

A new high- and low-temperature environmental testing chamber that incorporates a removable dry-ice compartment as a source of cold air has been made available. Temperature range of the chamber is from  $-100^{\circ}\text{F}$  to  $+200^{\circ}\text{F}$ . Reported pull-down is from ambient temperature to  $-100^{\circ}\text{F}$  in approximately 60 min;  $+200^{\circ}\text{F}$  can be reached in approximately 30 min; interior volume is 8 ft<sup>3</sup>; temperature control is automatic; and either indicating or recording instrumentation is available. (Tenney Engineering, Inc., Dept. Sc., 1090 Springfield Rd., Union, N.J.)

VirTis UltraBae filter is a single all-glass unit that serves for both ultrafiltration and bacteriological filtration. With a vacuum port provided in the collection flask and a pressure port provided in the upper reservoir—along with a port for filling—the instrument can be operated with either pressure or vacuum. All parts can be disassembled for cleaning, but the filter can also be autoclaved as a unit. UltraBae is available in two sizes, one equipped with a  $\frac{5}{8}$ -by 8-in. candle and a 125-ml reservoir, the other equipped with a 1 by 8 in. candle and a 700-ml reservoir. (E. Machlett & Son, Dept. Sc., 220 E. 23 St., New York 10.)

A flame photometer with a meter calibrated directly in milliequivalents of sodium and potassium has been announced by Beckman. A pilot light and present adjustments give instantaneous and efficient flame operation. Moving the sodium or potassium lever into position automatically places the proper filter between the flame and the phototube and brings the correct calibration pots into operating position. Utili-

ties required for operation are natural gas or propane, compressed air, and electricity at 115 v, 50 to 60 cy/sec. (Beckman Div., Beckman Instruments, Inc., Dept. Sc., Fullerton 1, Calif.)

A new direct-reading syringe microburet permits microcolorimetric or microtitrimetric analysis to be carried out with final volumes of reaction mixture as small as 50 to 200  $\mu\text{l}$ lit. Volume deliveries are read on a 2-in. micrometer dial. The meter reading is directly proportional to the linear displacement of the syringe plunger, and 1000 scale divisions correspond to a displacement of 1 in. Five syringes for delivering volumes from 0.2 to 5.0  $\mu\text{l}$ it per scale division are available. (Micro-Metric Instrument Co., Dept. Sc., P.O. Box 884, Cleveland 23, Ohio.)

## Miscellaneous

The Engineers Joint Council, New York, has announced the election of the American Society of Refrigerating Engineers as a constituent society. Also announced is the election of the American Institute of Industrial Engineers as an associate, the first organization to become an E.J.C. associate.

A verbatim report of a symposium on the genetic, psychological, and hormonal factors in the establishment and maintenance of patterns of sexual behavior in mammals, mimeographed and bound in a 350-page volume, is being distributed to the participants. Approximately 40 extra copies have been prepared and will be made available to any qualified colleague for the price of \$3. Requests should be addressed to William C. Young, Department of Anatomy, University of Kansas, Lawrence, Kan., and should be accompanied by a check payable to the University of Kansas, RF-155.

Radioisotopes for all medical and agricultural research and research in medical therapy will be made available to domestic users at 20 percent of the catalog price by the U.S. Atomic Energy Commission, effective 1 July. Heretofore the AEC has subsidized only the distribution of those radioisotopes used for cancer research and therapy. The discount will not be available for radioisotopes used for routine clinical treatment. Users should make application to the AEC's Division of Biology and Medicine.

Actual tremors of major and minor earthquakes have been recorded and are available on one side of a disk entitled *Out of This World*. The reverse contains a collection of unexplained sounds that originated in the ionosphere. The earthquake sounds were produced by the movement of a pendulum indicator on a seismograph located in the Seismological Laboratory of California Institute of Technology. They represent the actual movement of the earth's crust at that point. The ionospheric sounds were recorded at Dartmouth College's Thayer School of Engineering. The record is available from Cook Laboratories, 101 2nd St., Stamford, Conn.

## Book Reviews

*Advances in Enzymology and Related Subjects of Biochemistry*. Vol. 15. F. F. Nord, Ed. Interscience, New York-London, 1954. x + 547 pp. Illus. \$11.

There is little that one may add to past reviews of this well-established series. Volume 15 continues the high standard set by the previous volumes.

The topics reviewed were carefully selected to serve both general and special interests. From the table of contents, it is evident that there are several chapters for the many who follow the very rapid advances made in the field of metabolism. Not only are there three chapters concerned principally with enzyme mechanisms, but there are also sections of other articles that include the studies of the mechanisms proposed for the action of the particular enzyme system or systems reviewed. Articles that are well written and that serve a definite and worth-while purpose are never out of place. Therefore, in my opinion, the articles on virology and immunology need no rationalization for their inclusion.

The chapters are "The mechanism of enzymic oxidation-reduction," by S. J. Leach; "Thermodynamique des réactions immunologiques," by René Wurmser; "Chemistry, metabolism, and scope of action of the pyridine nucleotide coenzymes," by Thomas P. Singer and Edna B. Kearney; "Alternate pathways of glucose and fructose metabolism," by Efraim Racker; "Enzymic mechanisms in the citric acid cycle," by Severo Ochoa; "The mechanism of action of hydrolytic enzymes," by H. Lindley; "Enzymatic synthesis of polysaccharides," by Maurice Stacey; "Urea synthesis and metabolism of arginine and citrulline," by S. Ratner; "Thiaminase," by Akiji Fujita; "Rennin and the clotting of milk," by N. J. Berridge; and "Die struktur des tabakmosaikvirus und seiner mutanten," by Gerhard Schramm.

HOWARD B. BENSUSAN

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University of Maryland School of Medicine

*Limit Distributions for Sums of Independent Random Variables*. B. V. Gnedenko and A. N. Kolmogorov. Trans. by K. L. Chung. Addison-Wesley, Cambridge, Mass., 1954. ix + 264 pp. \$7.50.

K. L. Chung has rendered a service to students of probability theory by making available in English much material previously accessible only in Soviet periodicals. In the translator's preface he states:

The systematic account presented here combines generality with simplicity, making some of the most important and difficult parts of the theory of probability easily accessible to the reader. Beyond a knowledge of the calculus on the level, say of Hardy's *Pure Mathematics*, the book is formally self-contained.

It seems to me that a more sophisticated mathematical background, including some knowledge of complex variable theory, is desirable if one is to read

the book without considerable study. The majority of those to whom it would appeal no doubt possess the proper insight into this field of study. The book begins with a brief discussion of measure theory pertinent to the subject of probability, and to help the reader overcome the difficulties of this subject, an appendix by J. L. Doob is included. There are a considerable number of explanatory footnotes by the translator, and an extensive bibliography.

This might well serve either as a textbook or as reference reading in a course in advance probability.

The nine chapters are divided into three main parts: Introduction; General limit theorems; and Identically distributed summands. Chung suggests possible groupings of the material for several purposes to which the book seems suited. The first two chapters could serve as a rigorous course in probability. Other parts could be combined to serve the needs of those interested in the fundamental facts of stable laws, the law of large numbers, the central limit theorem, and asymptotic expansions.

CLAYTON M. ZIEMAN

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U.S. Air Force Institute of Technology

*The Use of Stereographic Projection in Structural Geology*. F. C. Phillips. Edward Arnold, London, 1954. vi + 86 pp. Illus. \$3. (Distr. by St Martin's Press, New York 17.)

As a means of determining the three-dimensional angular relationships that exist between structural units, stereographic projection has the advantages of rapidity, ease of visualization, and adaptability to field methods. This is widely realized in North America, where at least two standard textbooks of structural geology now include an introduction to stereographic procedure, and where Bucher and others have popularized its use in solving everyday structural problems. Although it fills no obvious gap in the literature on this side of the Atlantic, Coles Phillips' book is nevertheless of value as a fairly comprehensive guide to procedures already described in scattered writings elsewhere. It assumes no previous knowledge of the subject and possesses extreme clarity of expression and of illustration.

Problems of which the stereographic method permits rapid solution, and which are dealt with here, include the obtaining of true dip from apparent dips, either measured at outcrop or along inclined angles of sight at a distance, as is the case in the interpretation of oblique aerial photographs; of plunge from pitch in a known plane; and of the attitude of intersection of oblique planes. The latter, for example, may be used in determining the direction of ore shoots, of plunging fold axes, and of traces of structures on inclined fault planes. Also described is the procedure employed to find the former attitude of

doubly-tilted strata and to determine the dip of laminated beds, in which a key horizon is lacking, that are cut by nonparallel drill holes.

An account is given of the manner in which stereographic projection aids the construction of block diagrams for illustrative purposes, while a further chapter, headed "Tectonic syntheses," deals with fabric analysis on equal-area and stereographic diagrams by procedures familiar to structural petrologists. An appendix explains the use of simple spherical trigonometry in verifying the correctness of plotting and, when necessary, as a more accurate substitute for the latter. A series of problem exercises and their answers and an extensive bibliography are provided. This latter partially mitigates the lack of more than passing reference to projection protractors and other field aids that have been devised by earlier authors.

J. M. CARR

Department of Geology, University of Illinois

**Tropical Soils.** A critical study of soil genesis as related to climate, rock and vegetation. E. C. J. Mohr and F. A. Van Baren. N. V. Uitgeverij, W. Van Hoeve, The Hague and Bandung; Interscience, London-New York, 1954. 498 pp. Illus. + plates. \$9.

Mohr is a recognized authority on tropical soils and is well known for his monumental work on the soils of equatorial regions, which he wrote between 1933 and 1938, and which Robert L. Pendleton translated from the Dutch and made available to English readers in 1944. The present volume was written at the invitation of the Royal Tropical Institute of Amsterdam and is much broader in scope than its predecessor, treating all tropical soils rather than just those of the former Netherlands Indies. In the task Mohr had the collaboration of an able younger associate, F. A. Van Baren.

The title calls attention to the climatic basis of soil formation and the first chapter, comprising one-fifth of the book, is entitled "Fundamental considerations of atmospheric climate and soil climate." In the earlier edition Mohr devoted a great deal of attention to the seasonal march of soil moisture and in this book the authors go even further and say that "in the study of soil genesis it is soil climate . . . which should be given foremost attention."

Of course, they do not overlook the role of rocks and rock minerals in soil formation. In fact, since both men are soil experts this is the part of their book in which they excel. One might wish that they had done as well with the climatic theme. It is probable that the real answers to the problem of origin of tropical soils will not be forthcoming until the methods of microclimatology and topoclimatology are understood and pressed into service. The authors intimate as much in their concluding section when they say that "the overhead climate is not the essential factor in soil genesis but soil climate, and many different soil climates can occur in one and the same zonal region looked at from an overhead-climate point of view."

There is no doubt that this is a very important book—important not to soil scientists alone but also to climatologists, geographers, and botanists as well. It should be highly recommended.

C. W. THORNTONTHWAITE

Laboratory of Climatology,  
Johns Hopkins University

**The Sun, the Sea, and Tomorrow.** F. G. Walton Smith and Henry Chapin. Scribner's, New York, 1954. xii + 210 pp. Illus. \$3.50.

The writing team of Chapin and Smith got off to an indifferent start with *The Ocean River*, but this book is so much of an improvement that it does not seem to have been written by the same people. Of late we have been bombarded with all sorts of opinions about the infinite riches of the sea, the billions of kilowatts to be generated from tidal energy, and the inexhaustible bowls of plankton soup that are to be had for the asking, that it is something of a shock to find a book in which these expectations are reduced to sensible orders of magnitude. This does not mean that the authors are gloomy pessimists; they have simply presented their discussion of "potential sources of food, energy and minerals from the sea" in a realistic manner, with adequate recognition of the magnitude of problems to be overcome and without extravagant estimates of food for untold billions of mouths. Their main emphasis is on the need for research and political and economic cooperation. We are only at the threshold of knowledge required to improve our utilization of the sea and its resources. In this context more emphasis should have been given to the fluctuations in pelagic stocks, such as that of the California pilchard, which may make a fishery uneconomical and seriously impair an established source of food.

Ostensibly a book for lay readers, *The Sun, the Sea, and Tomorrow* deserves the attention of those optimistic economists who have placed too much faith in Sunday supplement pieces.

JOEL W. HEDGPETH

Scripps Institution of Oceanography

**Abhandlungen aus der Sowjetischen Physik.** Folge III. Gesellschaft für Deutsch-Sowjetische Freundschaft. Robert Rompe, Ed. Verlag Kultur und Fortschritt, Berlin, 1953. 347 pp. Illus. + plates.

The book *Abhandlungen aus der Sowjetischen Physik* is a translation (in German) of 24 papers apparently representing typical or outstanding products of Soviet research. The exact reasons for bringing them forth in this form are not stated. The topics covered range widely but include statistical theory, Brownian motion, luminescence, cosmic rays, gas discharges, organic chemistry, and spectroscopy, to name a few. Of these, experimental and theoretical aspects of luminescence are the most strongly represented, with 10 papers.

In a paper on color centers in alkali halides, it appears that an original contribution was made, but no outstandingly new discoveries are presented. In this work, the photoelectric and optical absorption of silver chloride and silver bromide were studied as functions of wavelength and heat treatment. It was concluded that in the silver halides F-centers analogous to those already found in alkali halides are formed under the action of ultraviolet light, x-rays, or heat. The conclusions are of interest in connection with the theory of the latent photographic image.

It should also be pointed out that, although the publication date of the book is 1953, all the papers presented in this translation had previously appeared in Soviet journals during 1950 and 1951. For those who are interested in the subjects included in this volume, and who read German but not Russian, perusal of the book may be worth while.

W. C. DUNLAP, JR.

General Electric Electronics Laboratory,  
Syracuse, New York

**Modern Aspects of pH.** With special reference to plants and soils. James Small. Van Nostrand, New York, 1954. xi + 247 pp. Illus. \$5.

The technologic importance of pH measurements stems largely from the use of pH numbers to characterize the acidic and basic properties of a wide variety of materials—suspensions, solutions in non-aqueous media, and even soft solids. It is clear that these numbers have little or no significance in terms of hydrogen-ion concentrations, and none is usually needed. The operational definition of the "practical" experimental pH places these diverse measurements on a sound, reproducible basis and also clarifies the meaning of the pH in the rare instance where a fundamental interpretation is justifiable. Within the past 5 years, this approach has received the endorsement of the A.S.T.M., the National Bureau of Standards, and the British Standards Institution.

It is these "modern aspects" to which the title of this book refers. If the true pH factor is linked too closely to hydrogen-ion concentrations, the pH of a plant sap, for example, is not likely to be accurately determined. Within the compass of the new definition, however, the pH of plant sap is a number obtained by a prescribed experimental procedure. The earlier equivocations of concentration, activity, and liquid-junction potentials enter the picture only when the fundamental meaning of this experimental value is examined. Hence, the author's view that "the new empiricism" allows only first-decimal accuracy in pH values seems unjustified.

To counter a misleading title, the author, professor of botany at Queen's University, Belfast, has chosen the subtitle "With special reference to plants and soils." The work, an outgrowth of his earlier volume *pH and Plants*, is a readable and informative presentation of the role of pH in controlling the growth and color of plants and the activity of enzymes and plant

hormones. The significance of pH in agriculture and ecology is also treated, and there is a short chapter on industrial applications. Attractive features of the book are the convincing arguments for the utility of buffer index values and the discussion of the base avidities of surfaces and the "suspension effect." Both subjects have failed heretofore to receive the attention they deserve. The book will be of particular interest to botanists and agronomists. The paper and binding are of fair quality.

ROGER G. BATES

National Bureau of Standards

## New Books

**Two Years in the Antarctic.** E. W. Kevin Walton. Philosophical Library, New York, 1955. 194 pp. \$4.75.

**Experimental Cookery from the Chemical and Physical Standpoint.** Belle Lowe. Wiley, New York; Chapman & Hall, London, ed. 4, 1955. 573 pp. \$7.50.

**Animal Life in Deserts.** A study of the fauna in relation to the environment. P. A. Buxton. St Martin's Press, New York, ed. 2, 1955. 176 pp. \$4.25.

**Traité de Zoologie: Anatomie, Systématique, Biologie.** vol. XII, Vertebrés. Pierre P. Grasse, Ed. Masson, Paris, 1954. 1145 pp. F. 10,550.

**Let's Have a Better World.** A program for progress and survival. Daniel Wolford La Rue. Exposition Press, New York, 1955. 240 pp. \$4.

**Catalogue of the Type Specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick.** vol. I. J. F. Gates Clarke. British Museum Natural History, London, 1955. 332 pp. £3.

**Diseases of the Nervous System.** Described for practitioners and students. F. M. R. Walsh. Williams & Wilkins, Baltimore, ed. 8, 1955. 357 pp. \$7.

**Grain Crops.** Harold K. Wilson. McGraw-Hill, New York-London, ed. 2, 1955. 396 pp. \$6.50.

**Antibiotics Annual 1954-1955.** Proceedings of the 2nd annual symposium on antibiotics. Henry Welch and Felix Martí-Ibáñez, Eds. Medical Encyclopedia, New York, 1955. 1154 pp.

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## Technical Papers

### Protein of the Grain Membrane of Cattle Hide

Sam R. Hoover, Samuel J. Viola,  
Alfred H. Korn, Edward F. Mellon  
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Philadelphia, Pennsylvania*

The grain membrane is the skin tissue that becomes the outer layer of finished leather; therefore many of the excellent surface properties of leather depend upon it. The preservation of the grain surface without damage during the liming and bating of skins is a major problem in tanning technology. It is perhaps surprising that the chemical structure and properties of the grain membrane have not been established. Some investigators have considered it to be a specialized tissue similar to the reticular tissue of various organs, but in recent years it has been generally thought to be collagen in a special netlike layer.

Turley (1) carried out a careful chemical-histological study of cattle hide in an attempt to correlate the processes of tanning with the classical histological description of skin. He concluded that below the epidermis, which is removed during liming, is a hyaline layer overlying the grain membrane. He was not able to distinguish this hyaline layer in fresh steer skin but believed it could be demonstrated in limed hide. The next layer described was the grain membrane. The latter was stated to be a "thin band of fine felted connective tissue which forms the actual surface of the skin as seen in tanned leathers."

Kaye concluded that there was a specialized grain membrane of reticular tissue composed of the protein "reticulin" (2). Dempsey, in 1946, stated that the hyaline layer could be demonstrated in suitably prepared sections of delimed ox hide (3). She continued:

It is not altogether clear if the reticular network and the hyaline layer are separate entities, but this seems most likely in view of the apparent structurelessness of the layer in the delimed skin.

Küntzel rejected these views and stated that the grain membrane is collagen, which differs from the underlying collagen of the corium only through its close netlike coalescence of the fibrils and does not differ in chemical constitution (4). Stather accepts this explanation in his recent book (5).

Kramer and Little recently studied the reticulin of the renal cortex and concluded that it consists of an amorphous protein matrix, rich in carbohydrate, in which the collagen fibrils lie (6). They boiled this tissue for 15 min and found that both the soluble and insoluble portions were high in hydroxyproline and low in phosphorus and sulfur. On the basis of these data, they concluded that both the fibrous and amorphous protein components of reticulin are closely related to collagen. It is quite probable that the col-

lagen present was incompletely converted to gelatin by their procedure, and that the amorphous matrix remaining was highly contaminated with fibrous collagen, as their electron micrographs of boiled preparations indicate.

When the collagen of hide is completely removed by autoclaving or treatment with acid, the membrane of the grain surface remains, along with a filmy network of tissue derived from the lower layers of the skin. This filmy (reticular) material can be teased off, leaving a continuous sheet of grain membrane (Fig. 1).

Even though there is a great difference in thickness between calfskin and cattle hide, the yield of grain membrane is essentially the same per unit area of the skin. The yield of grain membrane varies slightly with position on the hide and also probably for each animal, but in general  $1.0 \pm 0.1$  mg dry weight is obtained per square centimeter of the original skin area. The membrane shrinks about 40 to 50 percent in area during the isolation process.

The total nitrogen and hydroxyproline (7) content determined on a number of samples prepared from the skins by autoclaving or treatment with various acids is shown in Table 1. The autoclaving was done in water at neutrality for two 3-hr periods at 22 lb pressure. The acid preparations were heated for 1 hr on a steam bath, except that the sulfuric acid preparation was for 24 hr at room temperature. All loose (reticular) tissue was removed and the samples were washed free of acid and gelatin before they were dried for analysis.

The membrane is predominantly protein, but the low nitrogen is indicative of the presence of a fair amount of carbohydrate material. The presence of



Fig. 1. Grain membrane of calfskin with filamentous material partially teased off. The blood vessels of the corium, which are clearly visible in the filamentous material, can be completely removed from the grain membrane.

Table 1. Composition of grain membrane.

Preparative method	Total N (%)	Hydroxyproline (%)
White hide (steer)		
10% $\text{Cl}_3\text{COOH}$	11.6	0.51
98% $\text{H}_2\text{SO}_4$	13.5	1.46
10% lactic acid	16.8	1.55
5% lactic acid	12.0	1.20
Calfskin		
5% lactic acid	—	1.07
10% tartaric acid	11.6	1.01
10% citric acid	12.6	1.04
Autoclaved	10.2	1.05
Autoclaved	13.3	1.54

carbohydrate was confirmed by the anthrone method. The low hydroxyproline content shows that the membrane cannot be considered to be collagen, for collagen contains about 13 percent of hydroxyproline. This is supported by an x-ray examination of the isolated grain membrane by L. P. Witnauer, which revealed an amorphous scattering completely lacking in the characteristic collagen pattern.

The isolated grain membrane was also found to be low in cystine content (0.8 percent Sullivan method) and, therefore, cannot be considered to be a keratin. The membrane was also found to be readily solubilized by trypsin.

The properties of the isolated grain membrane of cattle hide appear to be very close to those of elastin. Elastin is resistant to autoclaving and the action of acid and alkaline solutions. It contains small amounts of cystine and hydroxyproline and is digested by proteolytic enzymes. Since the filmy (reticular) material removed from the flesh side of the grain membrane seems to have properties similar to those of the grain membrane, the membrane probably has the same composition as the amorphous-matrix protein of reticular tissue, and this protein is probably elastin or a very similar protein. The presence of a dense layer of elastin on the surface of a hide seems to be contrary to histological findings. The preparative procedure would remove collagen and some other constituents so the grain tissue of the animal may be much more complex than the grain membrane isolated here.

Further work is in progress, and a complete report will be submitted to the *Journal of the American Leather Chemists Association*.

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30 March 1955.

## Tubular Structure of Collagen Fibrils

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Previous electron microscope studies of connective tissue have dealt almost entirely with fibrils teased from tendon or reconstituted preparations of relatively intact collagen fibrils. In this investigation, both transversely and longitudinally sectioned normal collagen fibrils have been examined.

The most interesting observation to date concerns the distinctly tubular appearance of collagen fibrils when they are viewed in section. The possibility of these fibrils being hollow structures was discussed by R. W. G. Wyckoff [*Connective Tissues* (Josiah Macy, Jr., Foundation, New York, 1952), p. 60], but a definite conclusion could not be drawn from the evidence then available.

Sections containing collagen fibrils were prepared from specimens of periodontal membrane (human and monkey), tail tendon (rat), Achilles tendon (rabbit), cartilage (rat and rabbit), bone (rat, rabbit, and human), and skin (rat and rabbit). Small cubes of tissue were fixed in neutral formalin, dehydrated in cellosolve, and imbedded in methacrylate. Sections were made with both a Minot international microtome and a Spencer rotary microtome equipped with a thermal expansion adapter. Following removal of the imbedding material, sections were mounted on Formvar substrate films and shadowed with palladium.

A transverse section of three collagenous principal fibers of human periodontal membrane is shown at low magnification in Fig. 1. It is evident that the component fibrils of these fibers are imbedded in an amorphous ground substance that imparts a cloudy appearance to the interfibrillar areas. The clarity with which the fine detail of individual fibrils can be seen at higher magnifications depends to a large extent on the successful removal of this investing material during the processing of the specimens. Part of a cross section of a single periodontal membrane fiber from which most of the ground substance was removed by prolonged washing in water immediately after fixation is shown in Figs. 2 and 3. The tubular character of the collagen fibrils is clearly evident.

In most cases enough ground substance remains on the surfaces of the fibrils to obscure the cross striations characteristic of collagen. A typical 640-A periodicity can often be seen on the interior surface of the wall when a fibril has been opened by oblique or longitudinal sectioning, as is shown in Figs. 4 and 5. A few fibrils small enough to escape longitudinal sec-

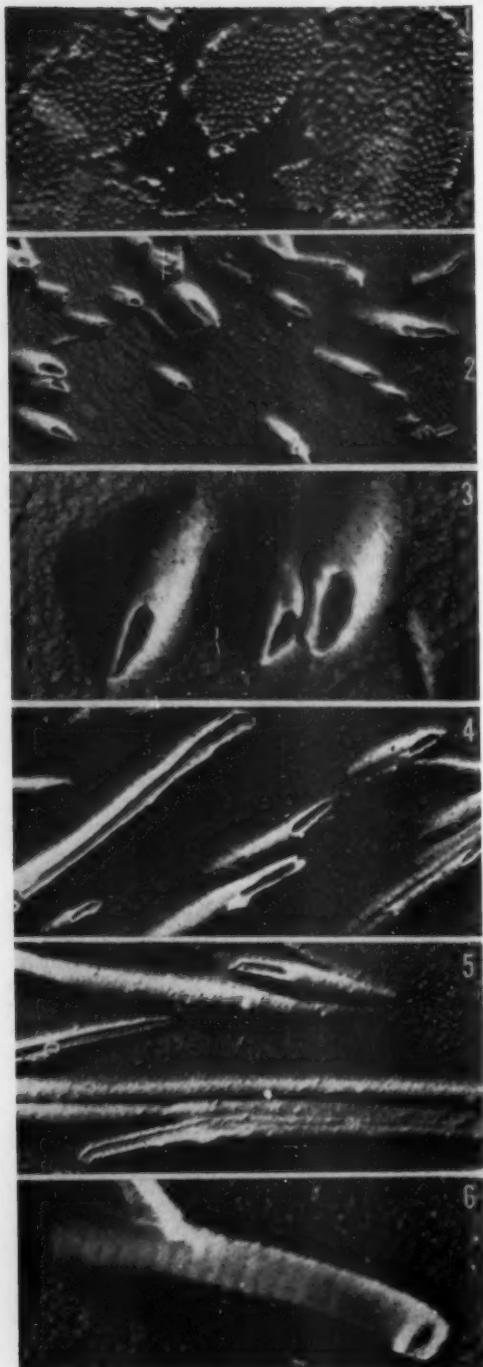


Fig. 1. Cross section of three collagenous principal fibers of human periodontal membrane showing component fibrils partially masked by amorphous ground substance. ( $\times 3000$ ) Fig. 2. Section of human periodontal membrane fibrils with ground substance partially removed. ( $\times 18,000$ ) Fig. 3. Higher magnification of three fibrils from Fig. 2. ( $\times 55,000$ ) Fig. 4. Oblique section of periodontal membrane fibrils. ( $\times 16,500$ ) Fig. 5. Human periodontal collagen fibrils, sectioned longitudinally, exhibit striations on the interior surface of the wall. Uncut fibrils appear cylindrical and show ground substance remaining on the exterior surface. ( $\times 21,000$ ) Fig. 6. Sectioned collagen fibril from rat tail tendon. Cut end at right shows tubular character, and 640-A striations are visible on the external surface. ( $\times 45,000$ )

tioning can also be seen. A fibril exhibiting both periodicity and tubularity is shown in Fig. 6. Because of the masking effect of residual ground substance, the number of instances in which these two characteristics have been seen simultaneously has been relatively small.

On the basis of the purely morphological evidence presented, the physiological significance of the tubular structure is not yet clear. The tubular character, however, has been common to fibrils of all tissues so far examined in this experiment.

10 January 1955.

### Method for Counting Tritium in Tritiated Water

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Many experimentalists overcome the difficulty of detecting the weak beta rays of tritium by counting tritium hydride as a component of the Geiger filling (1). This technique can be used for measuring the tritium in tritiated water by converting to tritium hydride, usually with zinc, at elevated temperatures (2). Although this procedure is satisfactory, it involves handling hydrogen at about  $400^{\circ}\text{C}$  and either mixing a three-component Geiger filling or using electronic quenching.

An alternative technique is the incorporation of THO in the detector of a liquid scintillation spectrometer (3). Although this procedure gives excellent measurements, it suffers from the high cost of the instrumentation (one excellent commercially available liquid scintillator costs about \$7500).

This paper establishes a simple, inexpensive method for measuring THO by a one-step conversion to acetylene with calcium carbide and Geiger counting of a self-quenching mixture of acetylene plus argon (4).

The reproducibility of this method is indicated in Table 1, which shows the sample converted, the partial pressure of the acetylene used, the net counts per minute, and the measured specific activity of the acetylene. All conversions were made with a large excess of

commercial calcium carbide that was not actually changed between many of the runs shown.

Mass spectra of this acetylene showed a great variety of impurity peaks. None of these impurities, however, interfered with the Geiger plateau or decreased the counting efficiency that compared within 1 percent with an argon-ethylene filling against an external radioactive standard.

In the experiments in Table 1, the yields of acetylene corresponded to the stoichiometry of the reaction



The magnitude of any fractionation of tritium between the acetylene and the calcium hydroxide was measured by comparison with the zinc method that eliminates fractionation by converting completely to hydrogen. Also, a comparison was made with a standard sample, using a liquid scintillation spectrometer (5). With the zinc method, the specific activity of the hydrogen of the THO was  $4.30 \times 10^6$  counts/min per mole, as is shown in Table 2. Thus, the specific activity of  $2.28 \times 10^6$  counts/min per mole for the acetylene (Table 1) corresponds to a constant fractionation of  $0.53 \pm 0.01$  (7). For most tracer studies, the reduction of specific activity by this fractionation and the 50-percent stoichiometric yield of acetylene are unimportant.

Thus, a simple procedure to measure THO is to evacuate a vessel containing a large excess of commercial calcium carbide, introduce a roughly measured portion of the tritiated water through a stopcock and small funnel, shake for a few minutes, pass the acetylene directly into an evacuated Geiger counter, measure the pressure accurately on a mercury manometer, add some argon, and count with an ordinary scaler. The partial pressures of  $\text{C}_2\text{H}_2$  and argon are not critical. In Table 1, roughly 11 cm-Hg of argon was used. The background is measured by repeating the procedure with tritium-free water or by using tank acetylene. The latter procedure provides a ready supply of acetylene for flushing the line to decontaminate between runs. If desired, the water samples may be

Table 1. Specific activity of THO by acetylene method.

Volume of $\text{H}_2\text{O}$ (ml)	Partial pressure of $\text{C}_2\text{H}_2$ (cm-Hg)	Net counts per minute	Specific activity of $\text{C}_2\text{H}_2$ (counts/min per mole)
0.10	4.80	269.3	$2.28 \times 10^6$
.10	5.00	283.4	2.30
.10	5.00	282.1	2.31
.10	5.40	309.6	2.33
.10	5.42	312.5	2.34
.10	5.70	327.0	2.33
.20	5.90	322.9	2.23
.15	5.90	327.5	2.26
.15	5.90	331.9	2.29
.10	5.90	328.5	2.27
.05	5.90	318.0	2.19
Average, $2.28 \pm 0.0019 \times 10^6$			

Table 2. Specific activity of THO by zinc method (6).

Partial pressure of $\text{H}_2$ (cm-Hg)	Net counts per minute	Specific activity of $\text{H}_2$ (counts/min per mole)
2.06	218.0	$4.30 \times 10^6$
1.8704	197.6	4.295
1.9130	198.0	4.242
1.7504	182.7	4.277
1.9040	206.0	4.395
2.3170	242.0	4.247
1.5290	163.2	4.340
Average, $4.299 \pm 0.0498 \times 10^6$		

measured accurately, and the entire yield of acetylene may be flushed into the counter with argon.

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4. This work was supported in part by the U.S. Atomic Energy Commission under contract AT(11-1)-166 with Purdue University.
5. A check on the specific activity of the THO was made against a Los Alamos standard of E. C. Anderson using a liquid scintillation spectrometer, the Packard Tri-Carb Counter, loaned by Lyle Packard. The result checked the value of the zinc method within experimental error.
6. The data of Table 2 were obtained on the same sample of THO and with the same counter used in Table 1. This counter was provided according to our specifications by the N. Wood Counter Laboratory and is now available commercially from this company in Chicago.
7. *Note added in proof.* This fractionation is probably complex and due, partly, to some isotopic exchange. The reproducibility, however, makes the method quantitative.

6 January 1955.

#### Ability of the Bobwhite to Grow and Reproduce without a Dietary Source of Vitamin $\text{B}_{12}$

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Several research workers have demonstrated the need of poultry for a dietary source of vitamin  $\text{B}_{12}$  for production of hatchable eggs. Carver and McGinnis (1) and Peterson *et al.* (2) found that dietary supplements of animal protein factor (APF) and vitamin  $\text{B}_{12}$  or fish meal were successful in increasing the hatchability of eggs produced by hens on all-vegetable diets. Oleese and Couch (3) obtained high hatchability by injections of vitamin  $\text{B}_{12}$  into eggs of hens reared on an all-vegetable diet. Thus, despite evidence that APF and fish meal contain essential factors other than vitamin  $\text{B}_{12}$  (4), it seems that hatchability serves as prima-facie evidence of adequate vitamin  $\text{B}_{12}$  in the poultry diet.

Soil has been shown to contain vitamin- $\text{B}_{12}$  activity (5), and many intestinal microorganisms have the

ability to synthesize vitamin B<sub>12</sub> (6). It has been found that poultry can obtain an adequate dietary supplement of this vitamin by coprophagy (7). Therefore, it is necessary to rear these fowl in wire-floored pens in order to demonstrate vitamin-B<sub>12</sub> deficiency. The requirement of poultry for a dietary source, however, indicates that little of the vitamin synthesized in the digestive tract is absorbed by the chicken.

A study at the Patuxent Research Refuge on requirements of the bobwhite (*Colinus virginianus*) for vitamin B<sub>12</sub> and on availability of this vitamin in soil indicates that this species is more efficient than domestic poultry in meeting its needs by utilizing the vitamin synthesized in the digestive tract.

Ninety bobwhite chicks, 2 wk old, were distributed equally into three wire-floored pens. Each group was given the same basic diet (Table 1) with the following modifications: group 1 received the unsupplemented diet; group 2 received approximately 150 µg of vitamin B<sub>12</sub> in 10 kg of diet; and group 3 received 200 g of dried soil in 10 kg of diet.

The quail were weighed at 2-wk intervals during the experiment. In February, 12 pairs (4 pairs from each group) were placed in breeding pens. Others were sacrificed.

Eggs were collected daily and incubated in lots at 2-wk intervals. After three clutches were incubated, 10 eggs from each group were analyzed at the U.S. Department of Agriculture, Poultry Research Laboratory, to determine levels of vitamin B<sub>12</sub>.

No significant difference was found in the rate of growth or the general condition of the birds in the three groups. All pairs mated, and egg production was normal. Hatchability was fair in all groups (Table 2), although it was slightly higher in the group that received the vitamin-B<sub>12</sub> supplement.

There was a higher level of vitamin-B<sub>12</sub> concentration in yolks from eggs of bobwhites receiving the

Table 1. Basic diet. To 100 kg of the basic diet, the following vitamin supplement was added: choline chloride, 40 g; folic acid, 40 mg; riboflavin, 800 mg; and calcium pantothenate, 800 mg.

Item	Percentage
Yellow corn meal	41.0
Soybean meal	42.0
Wheat middlings	10.0
Alfalfa leaf meal	4.0
Calcium carbonate	2.0
Vitamin-A and vitamin-D oil	0.5
Iodized NaCl (plus 0.5 percent manganese sulfate)	0.5
	100.0

Table 2. Fertility and hatchability of eggs.

Group	Eggs incubated	Eggs fertile	Fertility (%)	Chicks hatched	Hatchability (%)
1	139	112	80.6	78	69.6
2	151	126	83.4	95	75.4
3	148	118	79.7	75	63.5

Table 3. Vitamin B<sub>12</sub> in yolks (µg/g of yolk).

Group	Vitamin B <sub>12</sub>
1	.022
2	.042
3	.029

vitamin-B<sub>12</sub> supplement. Bobwhites receiving a soil supplement produced eggs with slightly more vitamin B<sub>12</sub> than those on the unaltered basic diet (Table 3). Eggs from all groups had a level of vitamin B<sub>12</sub> at least as high as is considered normal for hatchable poultry eggs.

The large supplement of vitamin B<sub>12</sub> given to group 2 apparently resulted in increased storage in the egg. The amount of the vitamin available in the soil supplement did not, however, cause a significant increase over the amounts stored by bobwhites without the dietary supplement.

Both fertility and hatchability were higher in eggs from bobwhites receiving the vitamin supplement. Because of the small number of breeders in each group, however, and the rather high individual variation in these characteristics, the differences are not considered significant.

The relatively large storage of vitamin B<sub>12</sub> in the yolk of eggs from bobwhites being fed a diet deficient in this vitamin and living under conditions where coprophagy was practically eliminated indicates that bobwhites must utilize the vitamin synthesized in their own digestive tracts. At any rate, the bobwhite does not appear to be dependent upon a dietary source of vitamin B<sub>12</sub> for survival or reproduction.

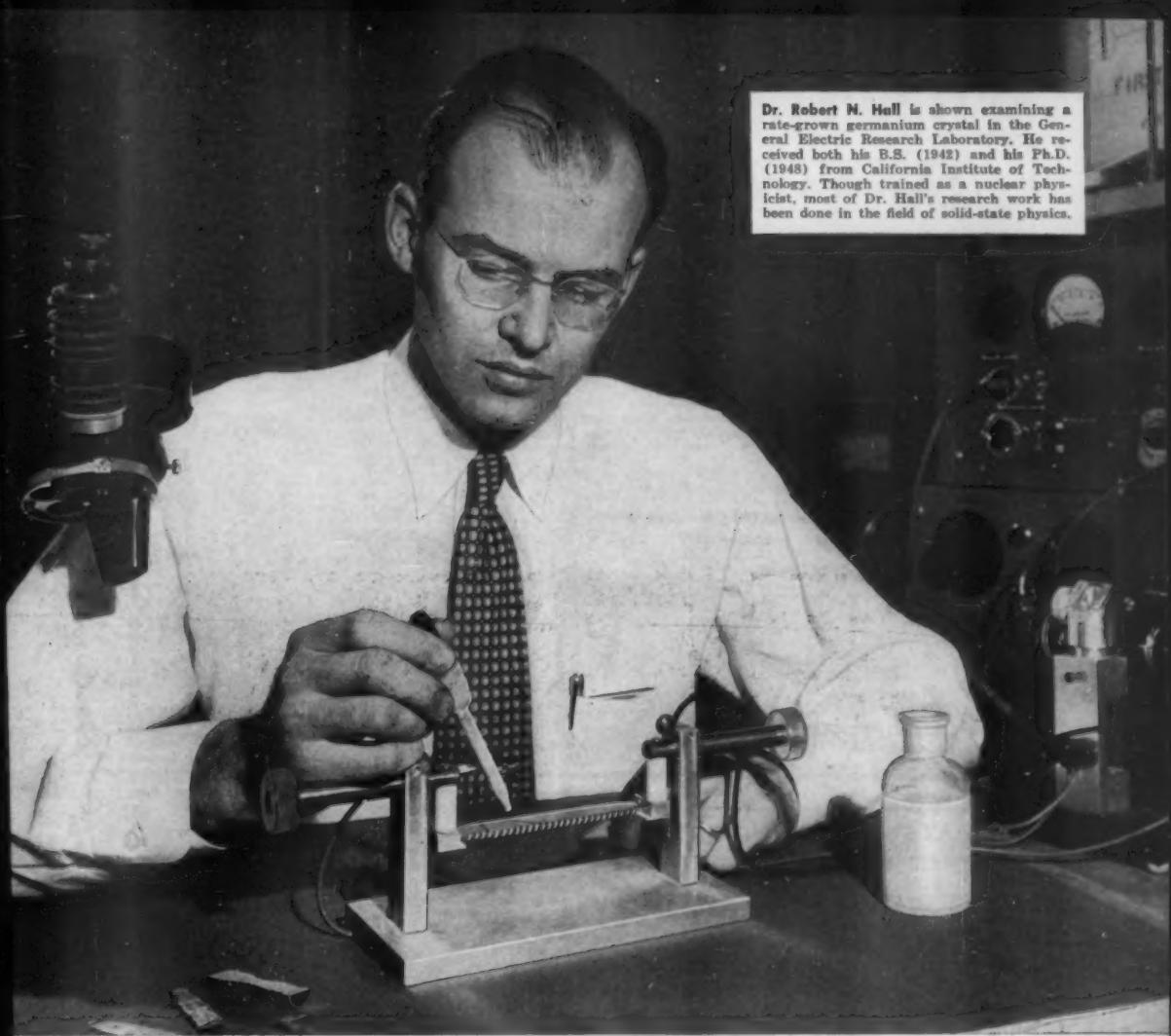
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6 January 1955.

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Dr. Robert N. Hall is shown examining a rate-grown germanium crystal in the General Electric Research Laboratory. He received both his B.S. (1942) and his Ph.D. (1948) from California Institute of Technology. Though trained as a nuclear physicist, most of Dr. Hall's research work has been done in the field of solid-state physics.

## Growing semiconductors

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generally regarded as the most suitable process known for the mass production of grown-junction transistors for high-frequency use. Dr. Hall is currently engaged in research on modifications of the *rate-growing process* which will make possible the preparation of units for amplification at still higher frequencies.

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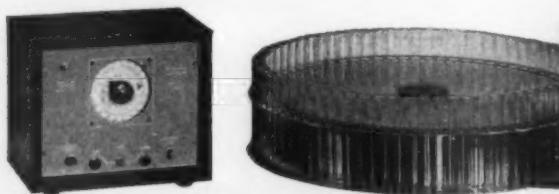
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### AAAS SYMPOSIUM VOLUME

## Sex in Microorganisms

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The genetic, physiological, and morphological evidence for "sex" in the principal groups of microorganisms—viruses, bacteria, fungi, unicellular algae, and protozoa—is presented by a group of experts in the field.

N. Visconti of the Carnegie Institution of Washington at Cold Spring Harbor, discusses recombination of "genes" in viruses. J. Lederberg of Wisconsin and E. L. Tatum of Stanford review genetic evidence for "sex" in bacteria, and W. C. Hutchinson of Pennsylvania and H. Stempel of Jefferson Medical College describe cell fusions in certain bacteria. J. R. Raper offers a comprehensive coverage of sex in fungi.

R. Patrick of the Academy of Natural Sciences, Phila-

delphia, describes syngamy in diatoms; R. A. Lewin of the Maritime Regional Laboratory, Halifax, the sexuality of other unicellular algae, especially the flagellates.

In two chapters D. H. Wenrich covers sexual phenomena in some of the protozoa and discusses the origin and evolution of sex, based primarily on the protozoa, but including material about all of the microorganisms. D. L. Nanney of Michigan summarizes mating-type phenomena in *Paramecium aurelia* and some of the recent mating-type work from Sonneborn's laboratory. C. B. Metz of Florida State compares mating-type substances in *Paramecium* and other ciliates with those found in Metazoa. Extensive chapter bibliographies are included.

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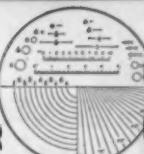
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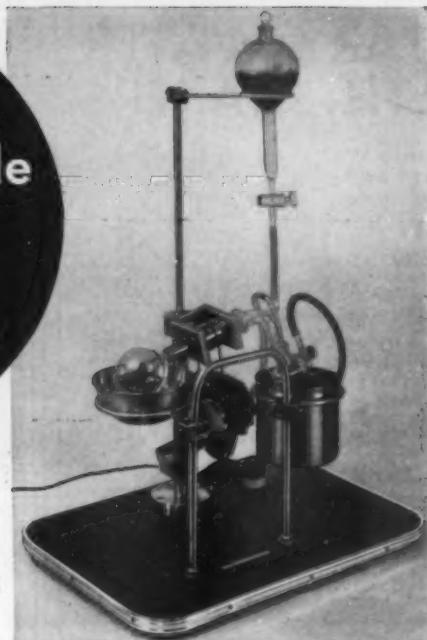
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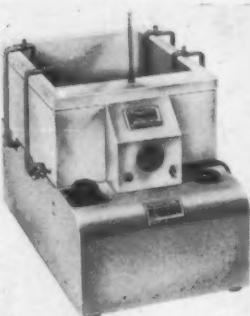
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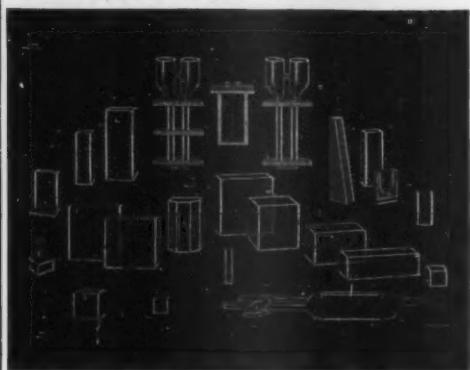


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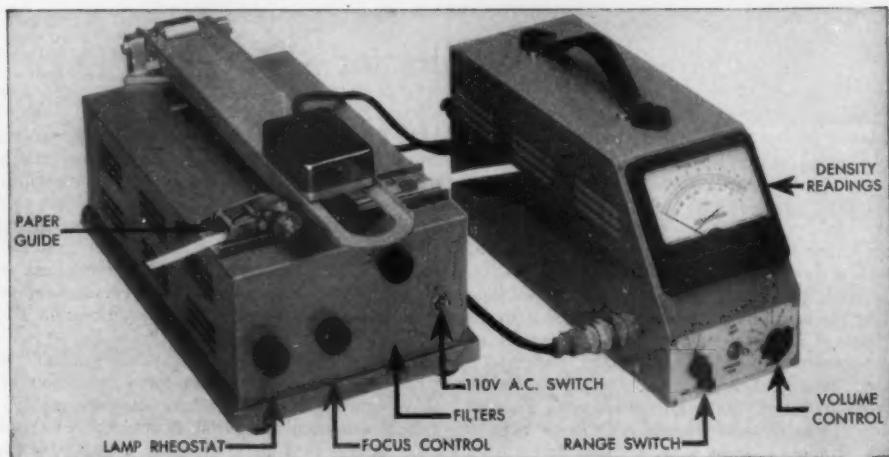
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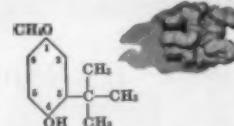
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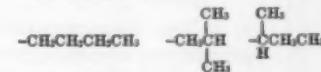
We are wooing the nut business (direct and in candy) with talk of wrapping materials, roasting oils, and

\*Nevertheless, we venerate highbrows, particularly for what they do with our film.

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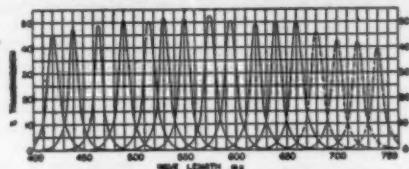
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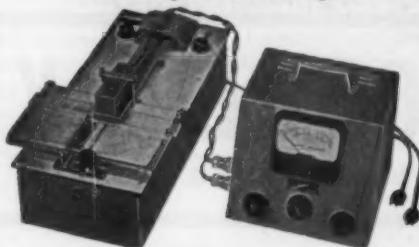
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## Meetings & Conferences

### June

6-10. American Medical Assoc., annual, Atlantic City, N.J. (G. F. Lull, 535 Dearborn St., Chicago 10, Ill.)  
6-10. Industrial Research Conference, 6th annual, Harriman, N.Y. (R. T. Livingston, 409 Engineering, Columbia University, New York 27.)  
6-15. World Petroleum Congress, 4th, Rome, Italy. (General Organizing Committee, 4th WPC, Via Tevere 20, Rome.)  
7. National Assoc. of Science Writers, annual, Atlantic City, N.J. (Rosamond R. Blakeslee, NASW, 5 Longview Rd., Port Washington, N.Y.)  
8-10. American Meteorological Soc., Kansas City, Mo. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)  
8-18. International Organization for Standardization, Stockholm, Sweden. (American Standards Assoc., 70 E. 45th St., New York 17, N.Y.)  
8-24. Joint Metallurgical Societies Meeting in Europe—London, Dusseldorf, and Paris. (W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.)  
9-10. Carbon Conference, Univ. of Buffalo, Buffalo, N.Y. (Carbon Conference, Dept. of Physics, Univ. of Buffalo, Buffalo.)  
9-21. Colloquium on Theoretical Physics, Ottawa, Canada. (T. Y. Wu, Div. of Physics, National Research Council, Ottawa 2.)  
10-12. American Electroencephalographic Soc., 9th annual, Chicago, Ill. (W. T. Liberson, Veterans Admin. Hospital, Northampton, Mass.)  
12-15. American Soc. of Agricultural Engineers, 48th annual, Urbana, Ill. (F. B. Lanham, ASAE, St. Joseph, Mich.)  
12-16. Special Libraries Assoc., Detroit, Mich. (M. E. Lusini, 31 E. 10 St., New York 3.)  
13-15. American Neurological Assoc., 80th annual, Chicago, Ill. (H. H. Merritt, Neurological Inst., 710 W. 168 St., New York 32.)  
13-16. National Organic Chemistry Symposium, 14th, Lafayette, Ind. (W. E. Parham, 347 Chemistry, Univ. of Minnesota, Minneapolis 14.)  
13-17. American Soc. of Civil Engineers, St. Louis, Mo. (W. N. Carey, ASCE, 33 W. 39 St., New York 18.)  
13-17. Symposium on Molecular Structure and Spectroscopy, annual, Columbus, Ohio. (H. H. Nielsen, Ohio State Univ., Columbus 10.)  
13-22. International Commission on Illumination, plenary meeting, Zurich, Switzerland. (C. A. Atherton, International Commission, Hopkinton, N.H.)  
14-16. Conf. and Exhibit on Magnetics, Pittsburgh, Pa. (R. Rimbach, 845 Ridge Ave., Pittsburgh 12.)  
15-17. Brookhaven Symposium in Biology No. 8, annual summer conf., Upton, L.I., N.Y. (R. C. King, Dept. of Biology, Brookhaven Natl. Lab., Upton.)  
15-17. Joint Conf. on Combustion, American and British, Boston, Mass. (American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18.)  
15-18. Colloquium of College Physicists, annual, Iowa City, Ia. (G. W. Stewart, Dept. of Physics, State Univ. of Iowa, Iowa City.)  
16-18. Symposium on Microscopy, sixth, Chicago, Ill. (W. C. McCrone, Armour Research Foundation, Technology Center, Chicago 16.)  
17-19. Soc. of Nuclear Medicine, Portland, Ore. (A. Littermore, Reed College, Portland.)

(See issue of 22 April for more comprehensive listings.)



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